Water and Wastewater Accelerator Toolkit

Allen-Bradley

Quick Start

Important User Information

Solid state equipment has operational characteristics differing from those of electromechanical equipment. Safety Guidelines for the Application, Installation and Maintenance of Solid State Controls (publication SGI-1.1 available from your local Rockwell Automation sales office or online at http://www.rockwellautomation.com/literature/) describes some important differences between solid state equipment and hard-wired electromechanical devices. Because of this difference, and also because of the wide variety of uses for solid state equipment, all persons responsible for applying this equipment must satisfy themselves that each intended application of this equipment is acceptable.

In no event will Rockwell Automation, Inc. be responsible or liable for indirect or consequential damages resulting from the use or application of this equipment.

The examples and diagrams in this manual are included solely for illustrative purposes. Because of the many variables and requirements associated with any particular installation, Rockwell Automation, Inc. cannot assume responsibility or liability for actual use based on the examples and diagrams.

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Throughout this manual, when necessary, we use notes to make you aware of safety considerations.

WARNING	Identifies information about practices or circumstances that can cause an explosion in a hazardous environment, which may lead to personal injury or death, property damage, or economic loss.
IMPORTANT	Identifies information that is critical for successful application and understanding of the product.
ATTENTION	Identifies information about practices or circumstances that can lead to personal injury or death, property damage, or economic loss. Attentions help you identify a hazard, avoid a hazard, and recognize the consequence
SHOCK HAZARD	Labels may be on or inside the equipment, for example, a drive or motor, to alert people that dangerous voltage may be present.
BURN HAZARD	Labels may be on or inside the equipment, for example, a drive or motor, to alert people that surfaces may reach dangerous temperatures.

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Introduction

The Water and Wastewater Quick Start Guide contains step by step instructions for using the Water and Wastewater Accelerator Toolkit (WWWAT). This toolkit is a valuable resource for designing, installing, operating, and maintaining a Water and Wastewater project. The WWWAT resides on a CD containing:

- Pre-configured files
- Selection tools
- Examples of using a Logix Controller to connect to multiple devices (PowerFlex AC drives, motors, and HMI terminals) over EtherNet/IP and DeviceNet networks.
- System architecture drawings
- CAD drawings
- Basic status, control, and diagnostic logic
- FactoryTalk View SE faceplates

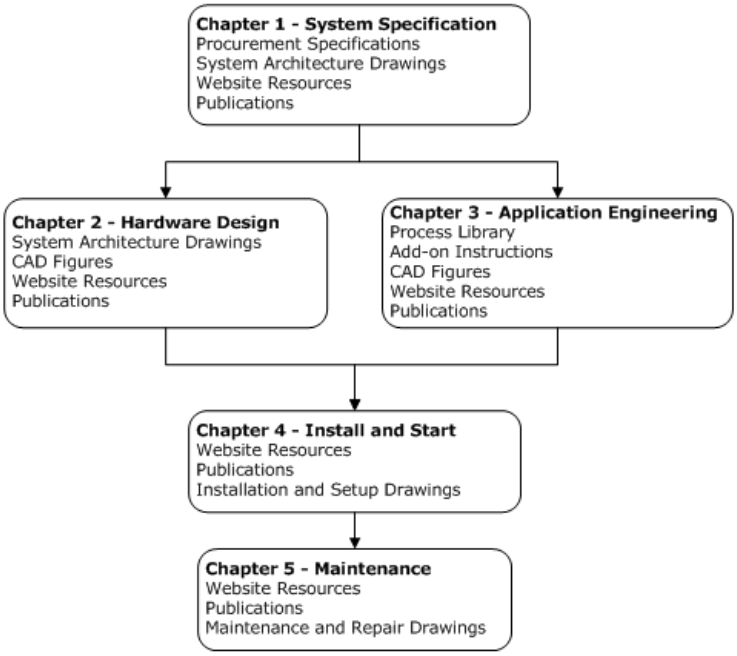
A new stand-alone Pump Controller Station Application based on the MicroLogix 1400 and PanelView Component C600 is also now included.

With these tools and the built-in best-practices design, the system designer is free to focus on their machine control design rather than designing overhead tasks.

Contact your local Rockwell Automation distributor or sales representative for a copy of the WWWATC CD (Publication IASIMP-SP012). You can also go to the Rockwell Automation Integrated Architecture Tools Website, http://www.ab.com/go/iatools and download the appropriate tools.

IMPORTANT Before using this guide and the contents of the WWWAT CD, read the Terms and Conditions README.pdf on the CD.

Use this flow chart to determine which chapters in this guide apply to your role in the Water and Wastewater project. Each chapter is organized according to the various Water and Wastewater project roles.



Water and Wastewater Quick Start Guide Chapter Organization

Once you've identified which section pertains to your role, read that section. Each section contains information on the existing documents' content, usage, and location. All of this material is provided to help you get started on your project. This guide answers questions such as:

- What hardware do I need?
- How should it be programmed?
- What software standards should I use?
- How do I install this hardware?

See Appendix A for further resources and updates to existing information.

Required Software

To utilize the applications provided in this Accelerator, the following software is required:

Rockwell Automation Software	Catalog Number	Version	Required For
RSlogix 5000 Control Flash BootP/DHCP Utility (EtherNet.IP) RSLinx Classic	9324-RLD300RNE	17 or later	All Water and Wastewater Controller Applications
FactoryTalk View Studio Site Edition FactoryTalk Services RSLinx Enterprises RSLinx Classic	9701-VWSBxxxAENE (xxx=number of screens required for the application)	5.0 or later	PanelView Plus Applications

Notes:

System Specification

Introduction

Use this chapter to learn about the Water and Wastewater product portfolio.

Procurement Specifications

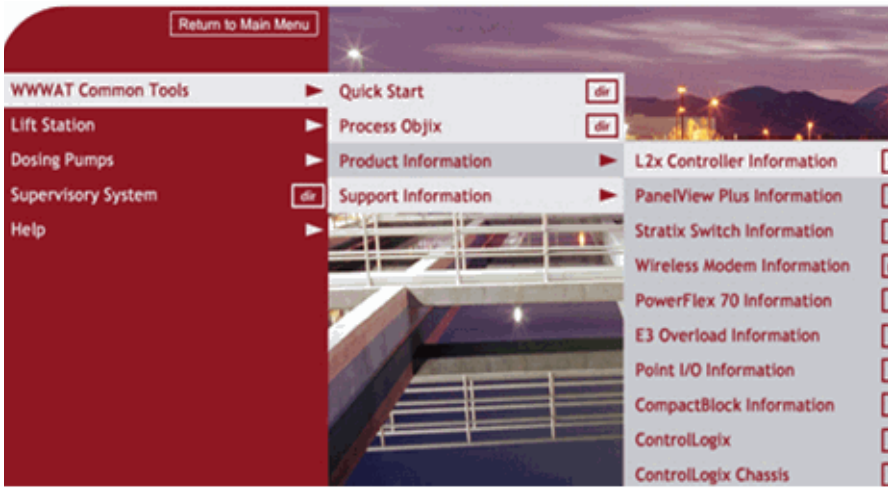
The Water and Wastewater Accelerator Toolkit (WWWAT) CD contains procurement documents to help you develop the appropriate Request for Proposals (RFPs). We suggest that you copy and then paste these documents directly into your bid documentation package. Our objective is to save you time when writing these specifications.

Most of the hardware referenced on the CD has an associated procurement specification. This hardware includes:

- ControlLogix controllers
- L2x Compactions controllers
- PanelView Plus HMIs
- PowerFlex 70 variable frequency drives
- Development Software

Go to the product information section on the WWWAT CD to access the appropriate procurement documents

WWWAT CD Product Information Menu



A procurement document can save you time by eliminating the need to create complex items such as the bid specification. You only have to copy and paste the contents of these documents directly into the project specifications section instead of developing the content yourself.

Customizing Procurement Documents

Typically, the procurement documents do not require editing. However, since all RFP's are unique in their requirements, you many need to use the following procedure to make the necessary changes.

1. Identify the section of the specification or RFP that is required. For example, is it a section on variable frequency drives or controllers?

2. Locate the appropriate procurement specification on the WWWAT CD.

3. Copy and paste the content of the procurement document into the specification or RFP.

4. Check the introduction of the new section that you've pasted into the specification. It is possible that you will need to change the introduction to better integrate into the existing document. The specification or RFP will already have a format and style, but some adjustments will be necessary to adhere to this style.

5. Check the format of the section numbering. Ensure that the procurement specification that you included matches the section numbering and does not disrupt the progression of section or page numbering.

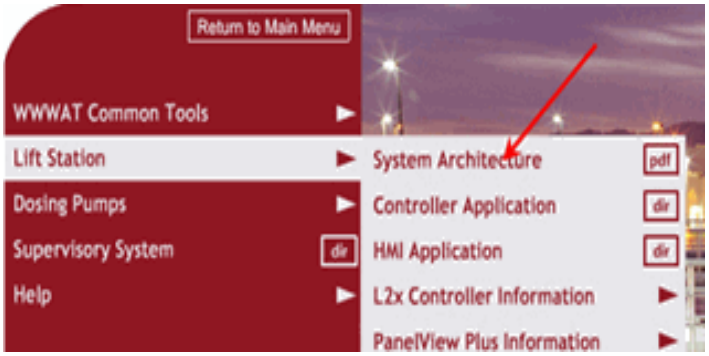
System Architecture Drawings

The system architecture drawings provide value in many stages of the project lifecycle. While specifying a system, these architecture drawings can be included in either the RFP or the proposal itself as an overview of the control system. With one illustration, they provide a summary of all the hardware components of the control system and the method of communication among all those components. They also let control engineers quickly understand the scope of the control system and grasp the control technologies involved. System architecture drawings are important early in the project life-cycle because they efficiently summarize the control strategy.

Accessing System Architecture Drawings

Go to the desired application and select the application of interest.

Selecting the System Architecture Application



Customizing System Architecture Drawings

System architecture drawings are intended to be used as a basis for your system design. They require modifications to illustrate your application correctly. Include the drawings in your RFP or the proposal itself.

Water and Wastewater Treatment Plant Drawings

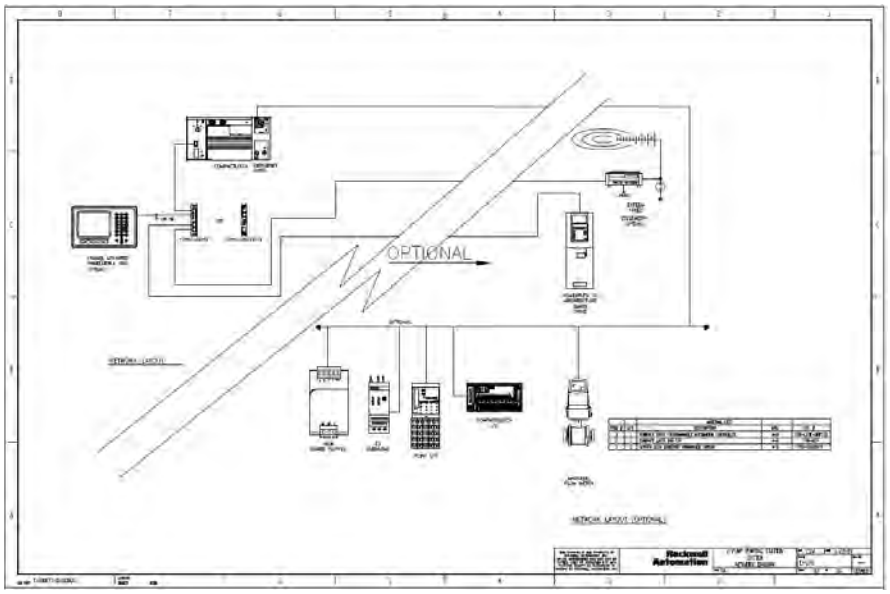
The Water and Wastewater Treatment Plant documentation package contains the following system-level architectural drawings:

- Lift Station System
- Dosing Pump Station System
- Primary Treatment System
- Headworks System
- Secondary Treatment System
- Solids Handling System

Lift Station System Architecture Drawing

The following is an example of a typical Lift Station System Architecture Drawing.

Lift Station System Architecture Drawing



The following table describes the key design points of the Lift Station System Architecture Drawing.

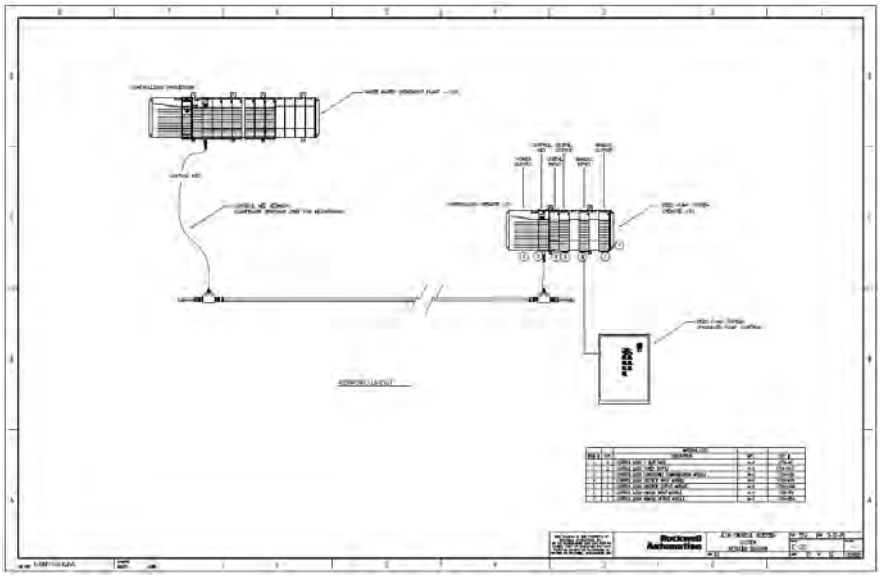
Hardware	Description
L23 Processor	Controls the Lift Station
EtherNet IP	Enables the HMI, hard drive, and system controller to communicate with each other
PanelView Plus	Human Machine Interface (HMI)
PowerFlex 70	Drives the pumps
DeviceNet	Controls I/O and other devices
Esteem Wireless Modem	Connects the Lift Station to the Supervisory System

The WWWAT CD contains architecture drawings that are only intended to be the basis for your application. Hardware modifications may be required to fulfill your application needs. Consider these points when designing the hardware for your application.

- The HMI shown in the Lift Station Architecture Drawing is a PanelView Plus 600 with a keyboard. Do you have another size screen preference? Do you prefer display only with no keypad?
- The pumps in this application are controlled via contactors. Optionally shown are a PowerFlex 70 Drives to run the pumps, and higher horsepower drives may require a different PowerFlex series drive.
- I/O on this sheet is optionally shown as both Point I/O and Compact Block I/O. Select an I/O style based on your requirements.
- The number of PanelView could change based on the operating procedures at your facility. Simply add more PanelView stations as needed.
- The number of contactors or PowerFlex 70 Drives could change based on the number of pumps in the Lift Station. Add more contactors or PowerFlex Drives, as needed.
- The Ethernet Switch shown has a limited number of ports. Select the appropriate Stratix switch as required for the number of EtherNet/IP devices in the system.
- IP addresses and node numbers should be included on this drawing. They are specific to your application.

Dosing Pump System Architecture Drawing

The following is an example of a typical Dosing Pump System Architecture Drawing.



Dosing Pump System Architecture Drawing

The following table describes the key design points of the Dosing Pump System Architecture Drawing.

Hardware	Description
ControlLogix Processor	Controls the Dosing Pumps
1756 Series	Controls I/O
Remote 1756 Chassis with Analog and Discrete I/O Devices	Communicates with the Dosing Pumps
ControlNet	Communicates with the Dosing Pump System

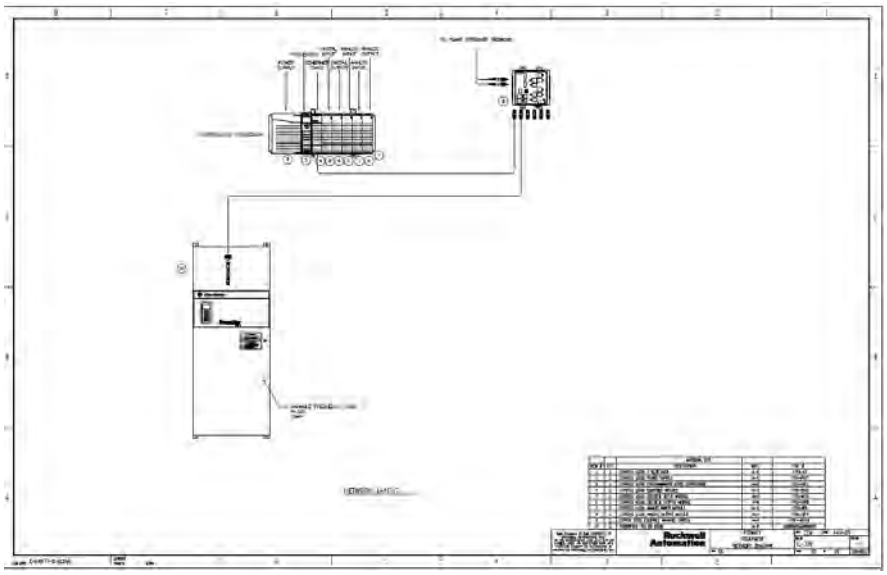
The WWWAT CD also contains System Architecture Drawings that are intended only to support your application. Hardware modifications may be required to fulfill your application needs. Consider these points when designing the hardware for your application:

- The Dosing Pumps are assumed to be run by a third party supplied controller. The ControlLogix interfaces to it via a remote chassis. This scenario should be reviewed and adjusted based on the strategy for the specific dosing pump control.
- The input and output card configuration in the remote chassis must be determined based on the specific needs of the inputs and outputs located in the proximity of that chassis.

Primary Treatment System Architecture Drawing

The following is an example of a typical Primary Treatment System Architecture Drawing.

.Primary Treatment System Architecture Drawing



The following table describes the key design points of the Primary Treatment System Architecture Drawing.

Hardware	Description
ControlLogix Processor	Controls the Primary Treatment System
1756 Series	Controls I/O
PowerFlex 700 Drive	Drives the pumps
EtherNet/IP	Establishes a communication path between the ControlLogix Processor, PowerFlex 700 Drive, and the plant network

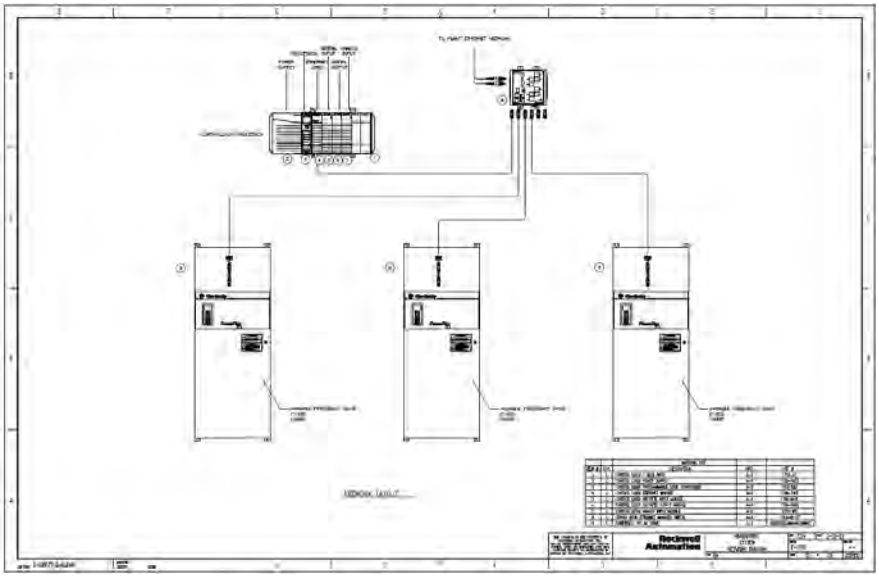
The WWWAT CD also contains System Architecture Drawings that are intended only to support your application. Hardware modifications may be required to fulfill your application needs. Consider these points when designing the hardware for your application:

- Each specific site must determine the 1756 Chassis I/O card configuration based on the specific needs of the I/O devices adjacent to that chassis.
- The number of PowerFlex 700 Drives may change based on the number of pumps in the Primary Treatment System. Add more drives as needed.
- The Ethernet Switch has a limited number of ports. Select the appropriate Stratix switch as required for the number of EtherNet/IP devices in the system.
- IP addresses and node numbers are unique to the application and you must include them on this drawing.

Headworks System Architecture Drawing

The following is an example of a typical Headworks System Architecture Drawing.

Headworks System Architecture Drawing



The following table describes the key design points of the Headworks System Architecture Drawing.

Hardware	Description
ControlLogix Processor	Controls the Headworks System
1756 Series	Controls I/O
PowerFlex 700 Drive	Drives the motors
EtherNet/IP	Establishes a communication path between the ControlLogix Processor, PowerFlex 700 Drive, and the plant network

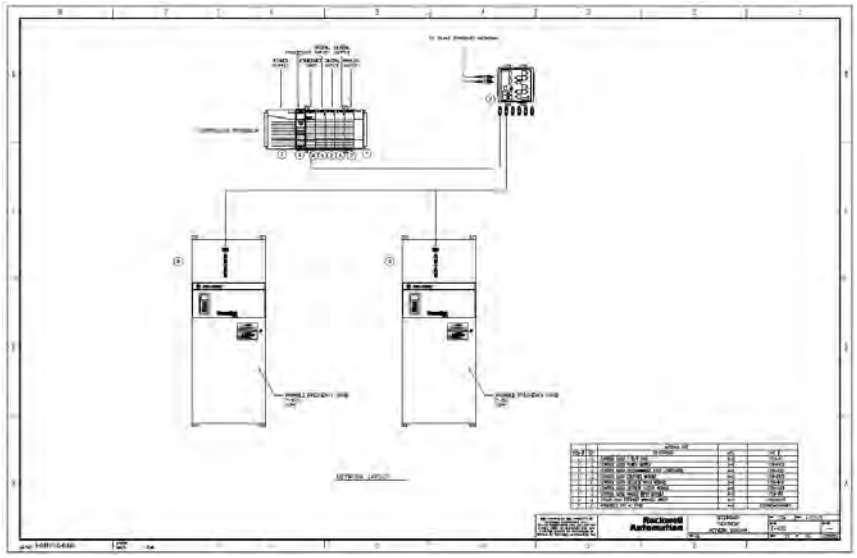
The WWWAT CD also contains System Architecture Drawings that are intended only to support your application. Hardware modifications may be required to fulfill your application needs. Consider these points when designing the hardware for your application:

- Each specific site must determine the 1756 Chassis I/O card configuration based on the specific needs of the I/O devices adjacent to that chassis.
- The number of PowerFlex 700 Drives may change based on the number of pumps in the Headworks System. Add more drives as needed.
- The Ethernet Switch has a limited number of ports. Select the appropriate Stratix switch as required for the number of EtherNet/IP devices in the system.
- IP addresses and node numbers are unique to your application and you must include them on this drawing.

Secondary Treatment System Architecture Drawing

This is a typical Secondary Treatment System Architecture Drawing.

Secondary Treatment System Architecture Drawing



The following table describes the key design points of the Secondary Treatment System Architecture Drawing.

Hardware	Description
ControlLogix Processor	Controls the Secondary Treatment System
1756 Series	Controls I/O
PowerFlex 700 Drive	Drives the pumps
EtherNet/IP	Establishes a communication path between the ControlLogix Processor, PowerFlex 700 Drive, and the plant network

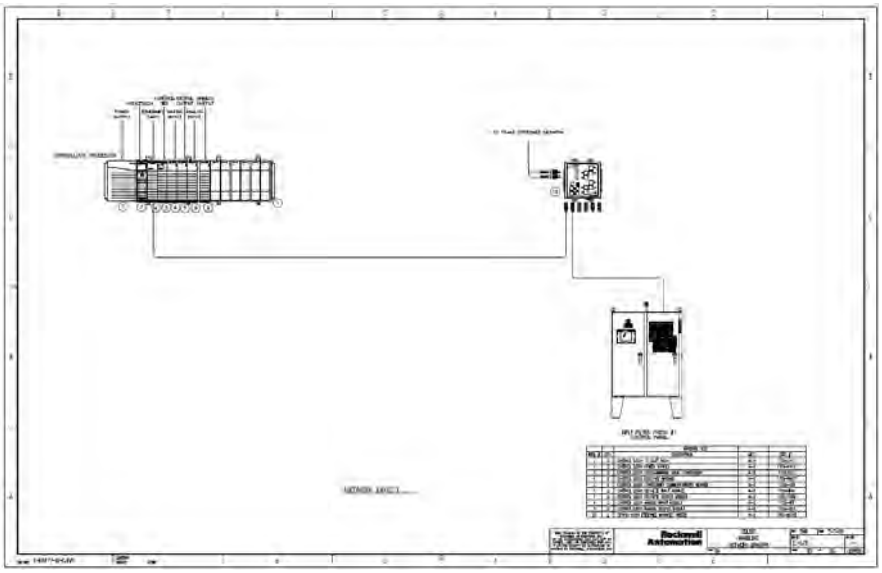
The WWWAT CD also contains System Architecture Drawings that are intended only to support your application. Hardware modifications may be required to fulfill your application needs. Consider these points when designing the hardware for your application:

- Each specific site must determine the 1756 Chassis I/O card configuration based on the specific needs of the I/O devices adjacent to that chassis.
- The number of PowerFlex 700 Drives may change based on the number of pumps in the Secondary Treatment System. Add more drives as needed.
- The Ethernet Switch has a limited number of ports. Select the appropriate Stratix switch as required for the number of EtherNet/IP devices in the system.
- IP addresses and node numbers are unique to your application and you must include them on this drawing.

Solids Handling System Architecture Drawing

This is a typical Solids Handling System Architecture Drawing.

Solids Handling System Architecture Drawing



The following table describes the key design points of the Solids Handling System Architecture Drawing.

Hardware	Description
ControlLogix Processor	Controls the Solids Handling System
1756 Series	Controls I/O
PowerView Plus	HMI
EtherNet/IP	Establishes a communication path between the ControlLogix Processor, Control Panels, and the plant network

The WWWAT CD also contains System Architecture Drawings that are intended only to support your application. Hardware modifications may be required to fulfill your application needs. Consider these points when designing the hardware for your application:

- Each specific site must determine the 1756 Chassis I/O card configuration based on the specific needs of the I/O devices adjacent to that chassis.
- The number of PowerFlex 700 Drives may change based on the number of pumps in the Solids Handling System. Add more drives as needed.
- The Ethernet Switch has a limited number of ports. Select the appropriate Stratix switch as required for the number of EtherNet/IP devices in the system.
- IP addresses and node numbers are unique to your application and you must include them on this drawing.

Water Treatment Plant Drawings

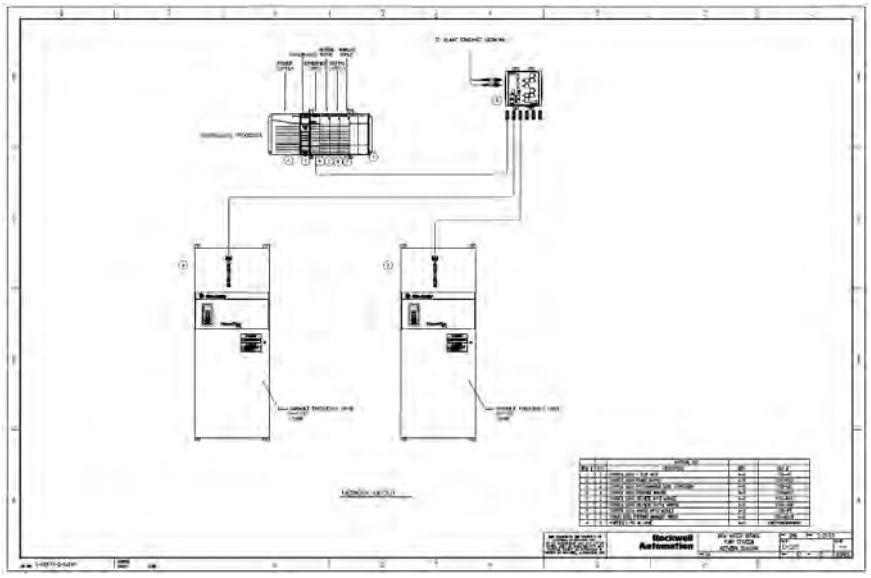
The Water Treatment Plant documentation package contains the following system-level architectural drawings:

- Raw Water Intake Pump Station System
- Separation Station System
- High Service Pump Station System

Raw Water Intake Pump Station System Architecture Drawing

This is a typical Run Water Intake Pump System Architecture Drawing.

Run Water Intake System Architecture Drawing



The following table describes the key design points of the Raw Water Intake Pump Station System Architecture Drawing.

Hardware	Description
ControlLogix Processor	Controls the Raw Water Intake Pump Station System
1756 Series	Controls I/O
PowerFlex 700 Drive	Drives the pumps
EtherNet/IP	Establishes a communication path between the ControlLogix Processor, PowerFlex 700 Drive, and the plant network

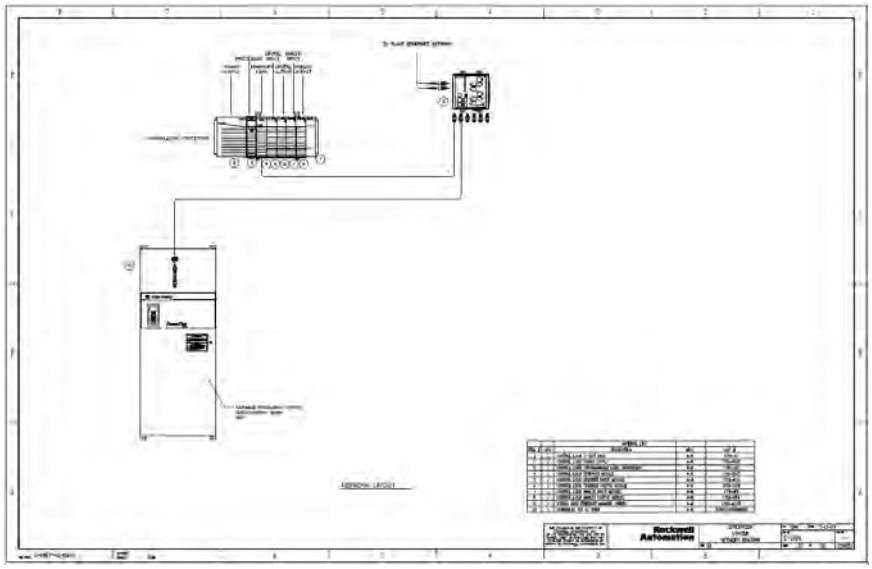
The WWWAT CD also contains System Architecture Drawings that are intended only to support your application. Hardware modifications may be required to fulfill your application needs. Consider these points when designing the hardware for your application:

- Each specific site must determine the 1756 Chassis I/O card configuration based on the specific needs of the I/O devices adjacent to that chassis.
- The number of PowerFlex 700 Drives may change based on the number of pumps in the Run Water Intake Pump Station System. Add more drives as needed.
- The Ethernet Switch has a limited number of ports. Select the appropriate Stratix switch as required for the number of EtherNet/IP devices in the system.
- IP addresses and node numbers are unique to your application and you must include them on this drawing.

Separation Station System Architecture Drawing

This is a typical Separation Station System Architecture Drawing.

Separation System Architecture Drawing



The following table describes the key design points of the Separation Station System Architecture Drawing.

Hardware	Description
ControlLogix Processor	Controls the Separation Station System
1756 Series	Controls I/O
PowerFlex 700 Drive	Drives the pumps
EtherNet/IP	Establishes a communication path between the ControlLogix Processor, PowerFlex 700 Drive, and the plant network

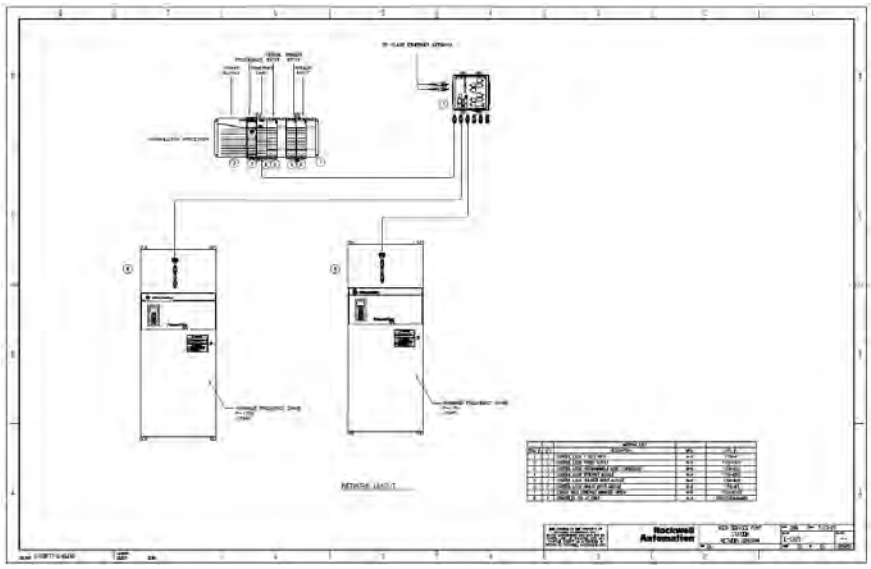
The WWWAT CD also contains System Architecture Drawings that are intended only to support your application. Hardware modifications may be required to fulfill your application needs. Consider these points when designing the hardware for your application:

- Each specific site manager must determine the 1756 Chassis I/O card configuration based on the specific needs of the I/O devices adjacent to that chassis.
- The number of PowerFlex 700 Drives may change based on the number of pumps in the Separation Station System. Add more drives as needed.
- The Ethernet Switch has a limited number of ports. Select the appropriate Stratix switch as required for the number of EtherNet/IP devices in the system.
- IP addresses and node numbers are unique to your application and you must include them on this drawing.

High Service Pump Station System Architecture Drawing

This is a typical High Service Pump Station System Architecture Drawing.

High Service Pump Station System Architecture Drawing



The following table describes the key design points of the High Service Pump Station System Architecture Drawing.

Hardware	Description
ControlLogix Processor	Controls the High Service Pump Station System
1756 Series	Controls I/O
PowerFlex 700 Drive	Drives the pumps
EtherNet/IP	Establishes a communication path between the ControlLogix Processor, PowerFlex 700 Drive, and the plant network

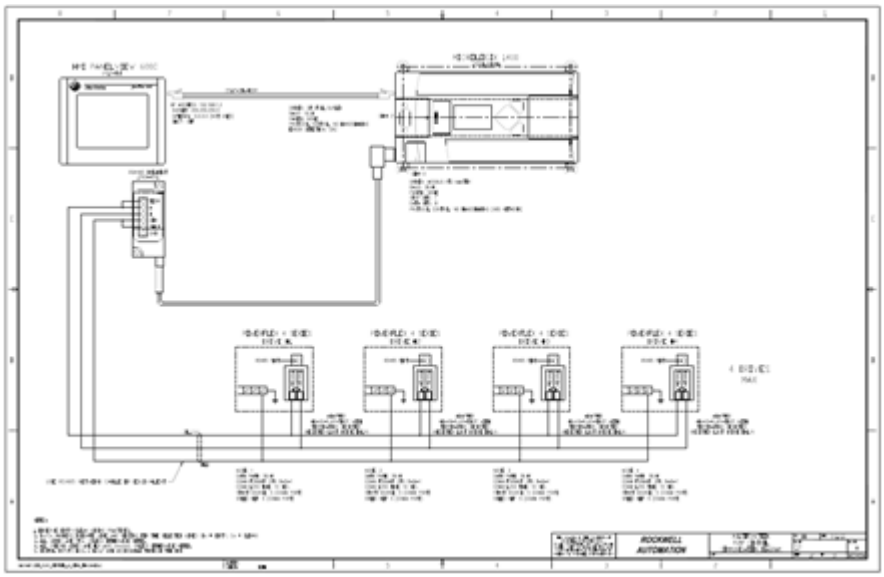
The WWWAT CD also contains System Architecture Drawings that are intended only to support your application. Hardware modifications may be required to fulfill your application needs. Consider these points when designing the hardware for your application:

- Each specific site manager must determine the 1756 Chassis I/O card configuration based on the specific needs of the I/O devices adjacent to that chassis.
- The number of PowerFlex 700 Drives may change based on the number of pumps in the High Service Pump Station System. Add more drives as needed.
- The Ethernet Switch has a limited number of ports. Select the appropriate Stratix switch as required for the number of EtherNet/IP devices in the system.
- IP addresses and node numbers are unique to your application and you must include them on this drawing.

Pump Controller Station Architecture Drawing

This is a typical Pump Controller Station Architecture Drawing.

Pump Controller Station Architecture Drawing



The following table describes the key design points of the Pump Controller Station Architecture Drawing.

Hardware	Description
MicroLogix 1400	Controls the Pump Station
PanelView Component C600	HMI
PowerFlex 4	Drives the Pumps

Additional Resources

The WWWAT CD contains links to numerous websites where you can find more information on the System Specification and Procurement phases of your Water and Wastewater project. For more information on websites and documentation that will help you plan and design your Water and Wastewater project, see Appendix A.

Hardware Design

Introduction

This chapter contains valuable resources to help you design the necessary Water and Wastewater hardware for your project.

Hardware Drawings

The WWWAT CD contains a System Architecture folder, which contains a drawing package for each application. Each of these drawing packages consists of a system overview and the basic electrical drawings for wiring the I/O. The Lift Station package also includes device-level wiring information. These examples can be used in the actual wiring of the field devices for the project.

Each Water and Wastewater project is unique. These hardware drawings provide you with a starting point for the hardware engineering. You must customize your project to meet your site requirements.

Water and Wastewater Treatment Plant Hardware Drawings

The Water and Wastewater Treatment Plant Hardware documentation package contains the following system-level drawing packages:

- Lift Station System
- Dosing Pump Station System
- Primary Treatment System
- Headworks System
- Secondary Treatment System
- Solids Handling System
- Chemical Feed System
- Flushing System

The Lift Station and Dosing Pump Station drawings are included in this section for reference. These are typical of the others- all can be found on the WWWAT CD (Publication IASIMP-SP012). You can also go to the Rockwell Automation Integrated Architecture Tools Website, http://www.ab.com/go/iatools and download the drawings.

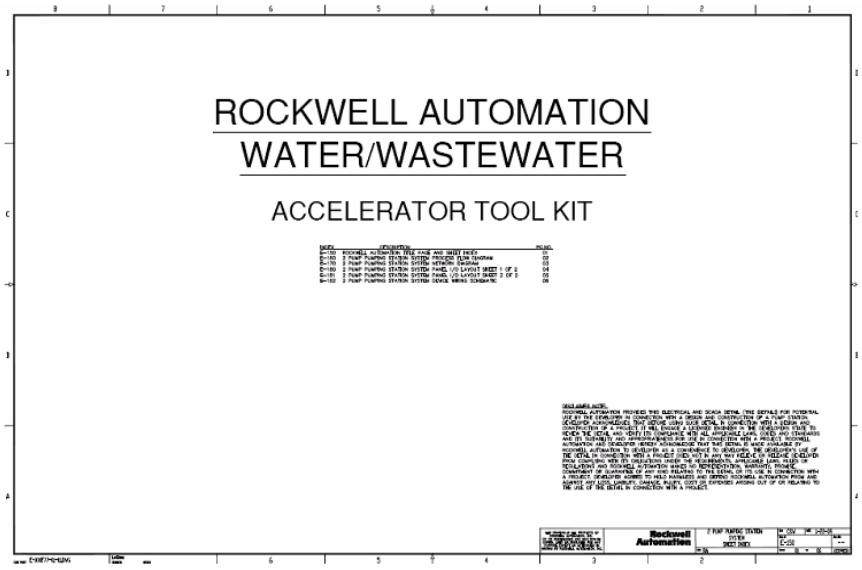
Lift Station Hardware Drawings

One of the System Architecture sub-folders on the WWWAT CD is the Lift Station folder and it contains the following drawings:

- Title Page and Sheet Index
- Process Flow Diagram
- Network Diagram
- Panel I/O Layout Sheets
- Device Wiring Schematics

Title Page and Sheet Index

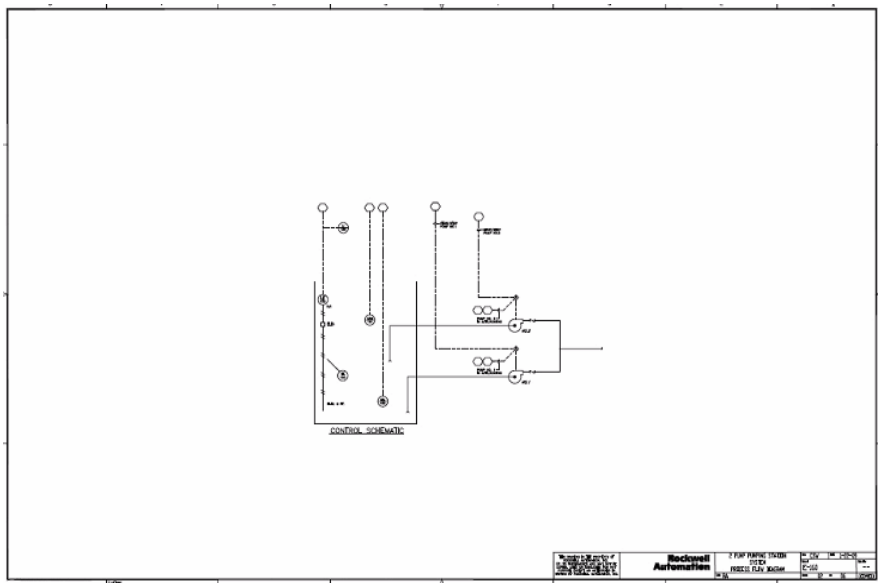
Lift Station Title Page and Sheet Index



Number	Title	Description
E-150	Title Page and Sheet Index	This is the Table of Contents/Cover Sheet for the drawing package. Modify this sheet as necessary to match the contents of the drawing package for your application.

Process Flow Diagram

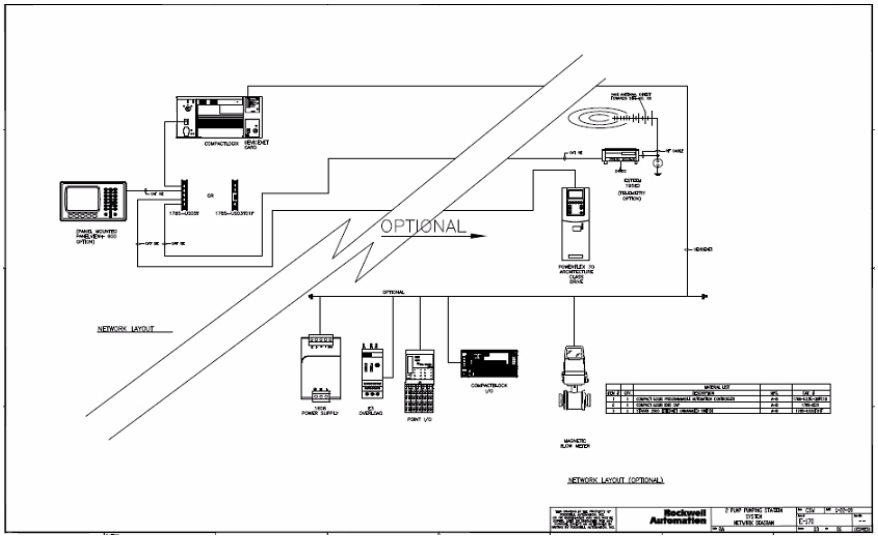
Lift Station System Process Flow Diagram



Number	Title	Description
E-160	System Process Flow Diagram	This diagram depicts a Lift Station consisting of two pumps with particular I/O. Any changes to the number of pumps or I/O for the Lift Station must be reflected on this diagram.

Network Diagram

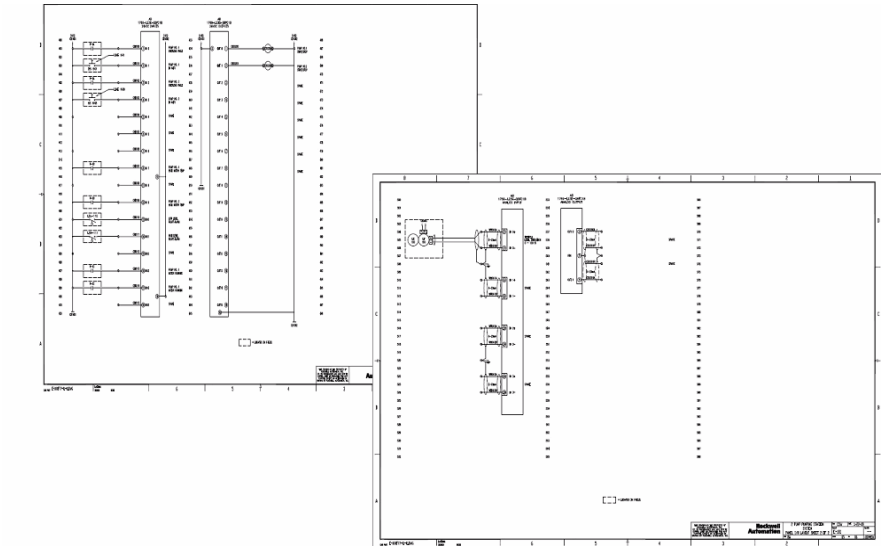
Lift Station System Network Diagram



Number	Title	Description
E-170	Network Diagram	For details, see page 12.

Panel I/O Layout Sheets

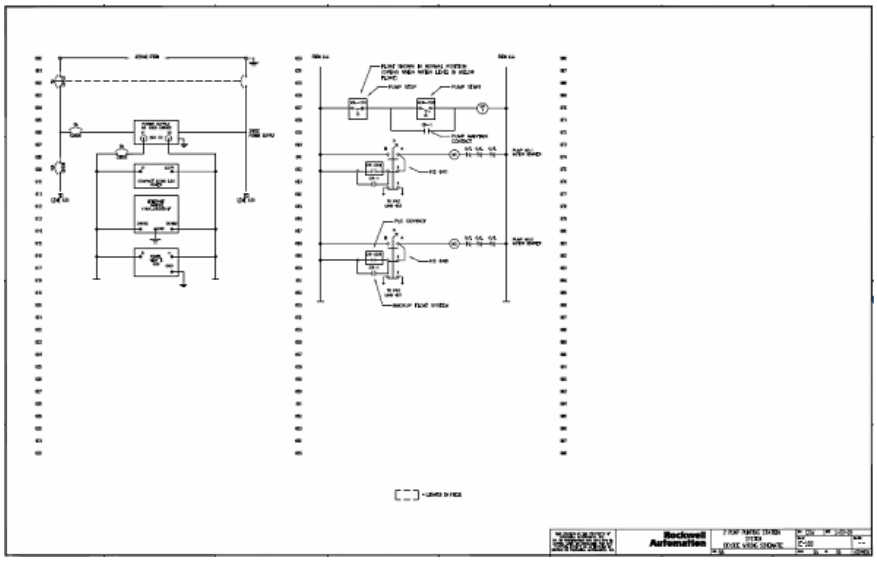
Lift Station System Panel I/O Layout Sheets



Number	Title	Description
E-180 E-181	Panel I/O Layout (Sheet 1 of 2) Panel I/O Layout (Sheet 2 of 2)	Inputs and outputs to the controller are shown on these diagrams. The format uses three cards per sheet. Inputs to the card are shown with the input device to the left of the input card. Output devices are shown to the right of the output card. For every additional input or output card, new sheets must be added. These sheets contain one example of each type of digital and analog I/O module typically used in a Lift Station application. **Note:** These modules are the input and output points physically located on the L23 controller. Different I/O modules require changes to these sheets. You should modify these sheets to show the I/O specific to your application. Use these sheets as a template for applications even if the specific I/O points vary.

Device Wiring Schematics

Lift Station System Device Wiring Schematics



Number	Title	Description
E-182	Device Wiring Schematics	This sheet provides power distribution and manual (hand) selector switch wiring information. For this application example, we recommend you use an Allen-Bradley power supply to feed the L23 power, Stratix Ethernet switch, and the PanelView Plus 600. Modify this sheet to show any additional 24-volt devices required in the design. During the project's Hardware Engineering phase, this 24 volt power supply must be accurately sized based on the current requirements of the devices connected to it.

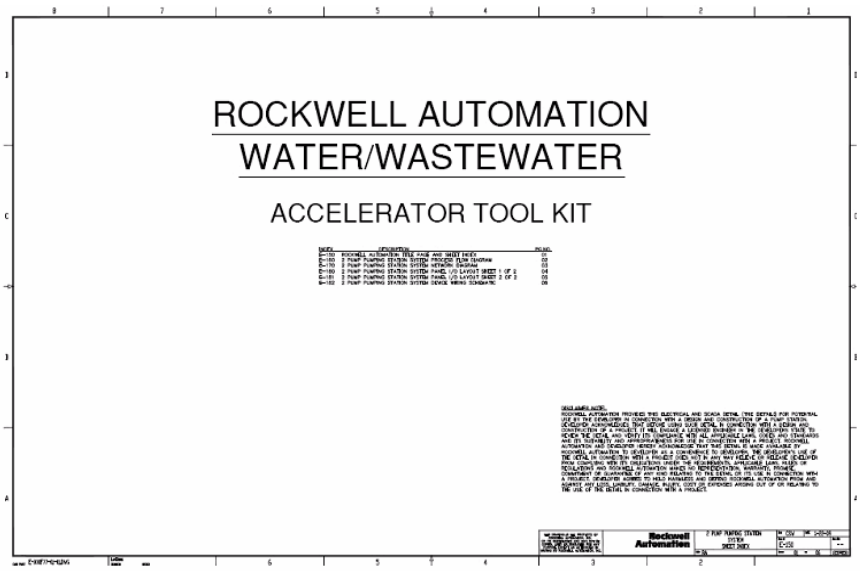
Dosing Pump Hardware Drawings

One of the System Architecture sub-folders on the WWWAT CD is the Dosing Pump folder and it contains the following drawings:

- Title Page and Sheet Index
- Process Flow Diagram
- Network Diagram
- Panel I/O Layout Sheets

Title Page and Sheet Index

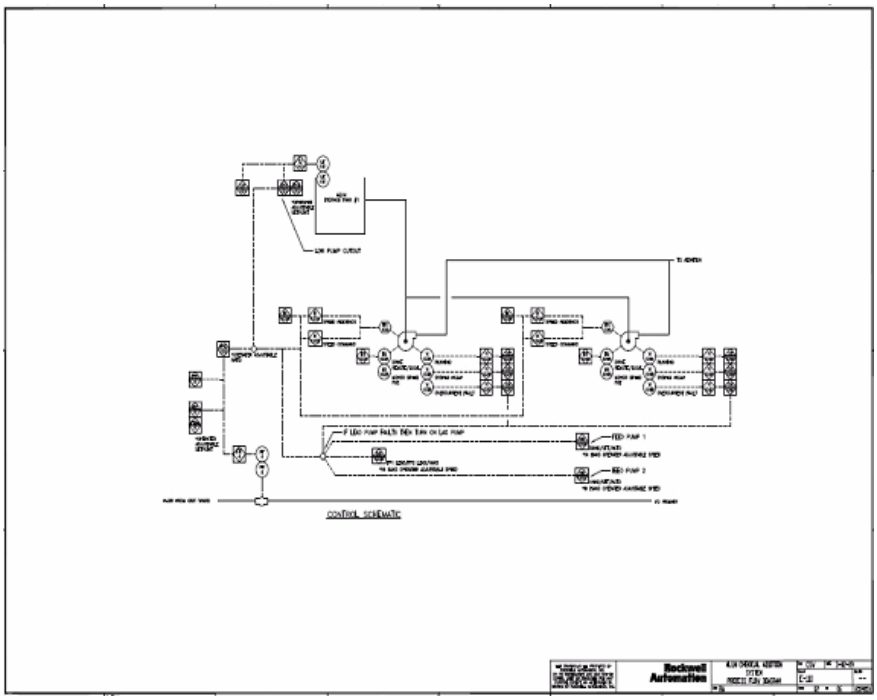
Dosing Pump Title Page and Sheet Index



Number	Title	Description
E-100	Title Page and Sheet Index	This is the Table of Contents/Cover Sheet for the drawing package. Modify this sheet as necessary to match the contents of your application's drawing package.

Process Flow Diagram

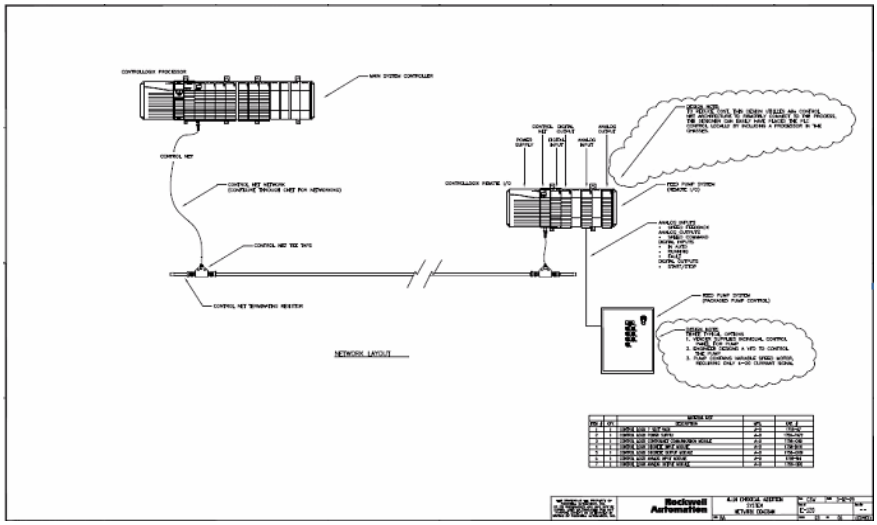
Dosing Pump System Process Flow Diagram



Number	Title	Description
E-110	System Process Flow Diagram	The Dosing Pump System Process Flow diagram depicts a two pump alum addition process. You make any changes to the number of pumps or I/O for this process on this drawing. For example, if you require additional pumps in an application, update this sheet with the appropriate pumps and their associated I/O information. The Dosing Pump System Process Flow diagram is very helpful for a quick summary of the controls and the process being controlled.

Network Diagram

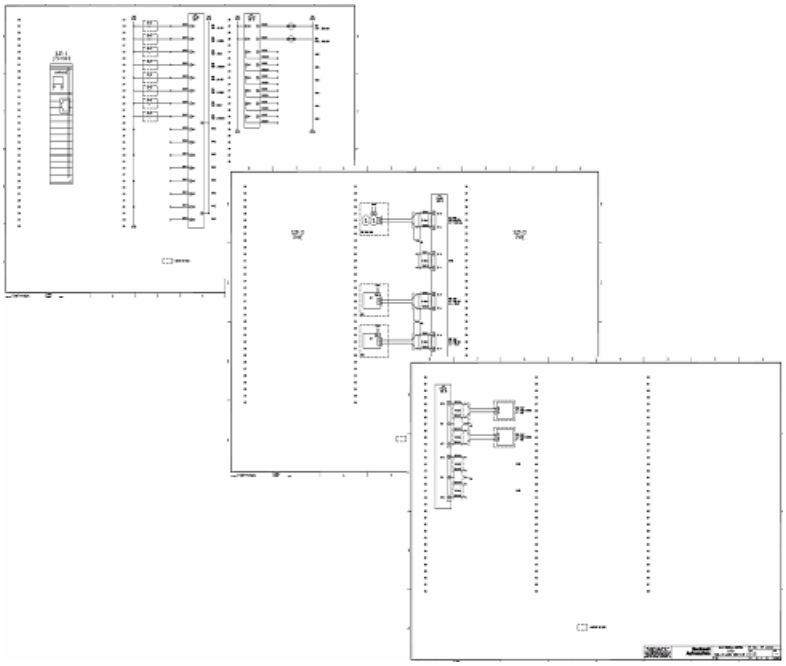
Dosing Pump System Network Diagram



Number	Title	Description
E-120	Network Diagram	For details, see page 14.

Panel I/O Layout Sheets

Dosing Pump System Panel I/O Layout Sheets



Number	Title	Description
E-130	Panel I/O Layout (Sheet 1 of 3)	These diagrams show the I/O to the controller. The format uses three cards per sheet. This drawing depicts inputs to the card with the input device to the left of the Input card. It also shows output devices to the right of the output card. You must add a new sheet for each additional input or output card. This drawing package was designed with space reserved for all the Controller Chassis card slots. In this example drawing package, slot 3 is empty. This empty slot is represented on sheet E-131 with an empty area on the sheet and the text "Spare." If you add a card to slot three, you should show it in this spare area. If an additional chassis is required, use this same format with space reserved in the drawings for any empty slots of the chassis. This provides a pre-determined location in the drawing package for all the I/O modules. Include I/O information specific to your application on this drawing. We expect you to modify these sheets to fit your application. You use these sheets as a template for use with many applications even though the specific I/O points vary. These sheets include digital input and output modules as well as analog input and output modules. The Dosing Pump Panel I/O Layout Sheet contains one example of each type of module that will typically be used in a lift station application. Note, that these modules are 1756 style I/O modules. Different I/O modules will require changes to these sheets.
E-131	Panel I/O Layout (Sheet 2 of 3)	
E-132	Panel I/O Layout (Sheet 3 of 3)	

Water Treatment Plant Hardware Drawings

The Water Treatment Plant (WTP) Hardware documentation package contains the following system-level drawing packages:

- Raw Water Intake Pump Station System
- Separation Station System
- High Service Pump Station System

The Raw Water Intake System Pump Station drawings are included in this section for reference. These are typical of the others- all can be found on the WWWAT CD (Publication IASIMP-SP012). You can also go to the Rockwell Automation Integrated Architecture Tools Website, http://www.ab.com/go/iatools and download the drawings.

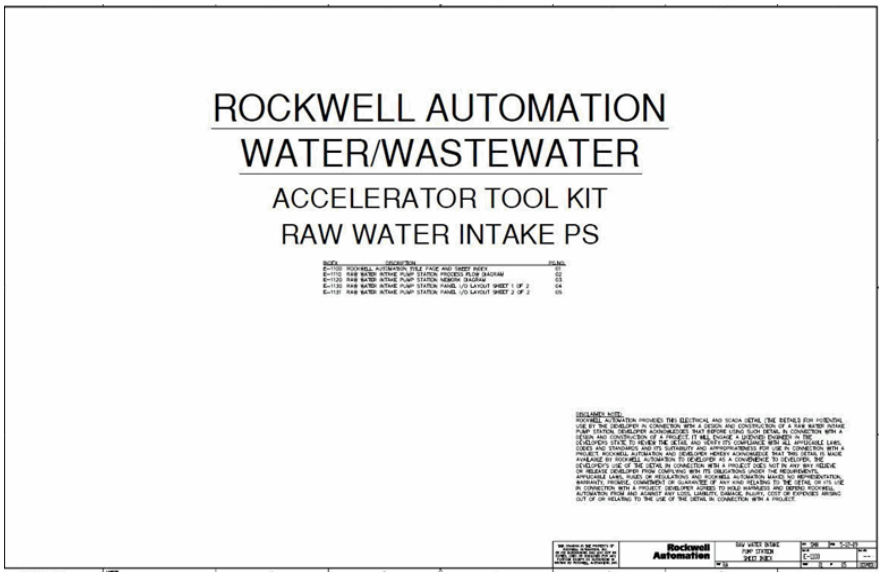
Raw Water Intake Pump Station System Hardware Drawings

The System Architecture folder on the WWWAT CD contains the Raw Water Intake System sub-folder. Select this sub-folder to view the following Raw Water Intake System drawings:

- Title Page and Sheet Index
- Process Flow Diagram
- Network Diagram
- Panel I/O Layout Sheets

Title Page and Sheet Index

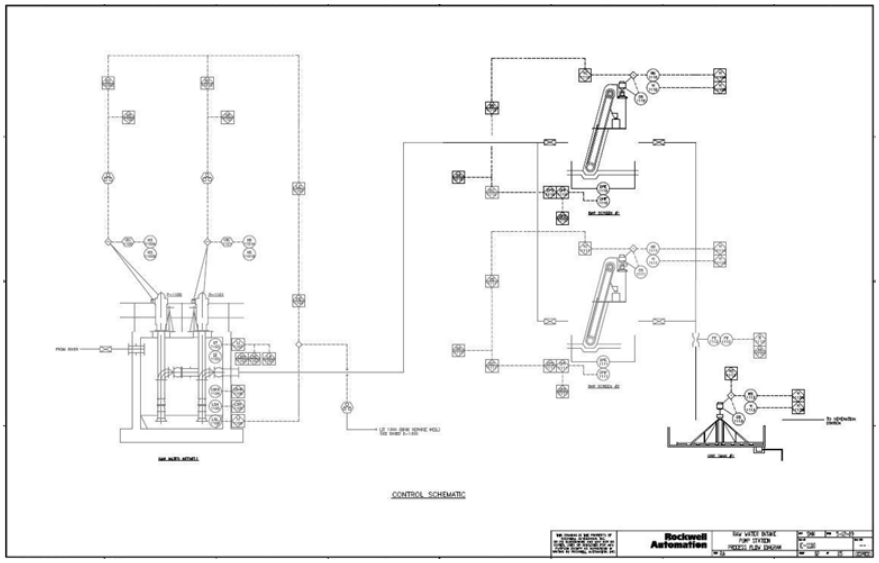
Raw Water Intake System Title Page and Sheet Index



Number	Title	Description
E-1100	Title Page and Sheet Index	This is the Table of Contents/Cover Sheet for the drawing package. Modify this sheet as necessary to match the contents of the drawing package for your application.

Process Flow Diagram

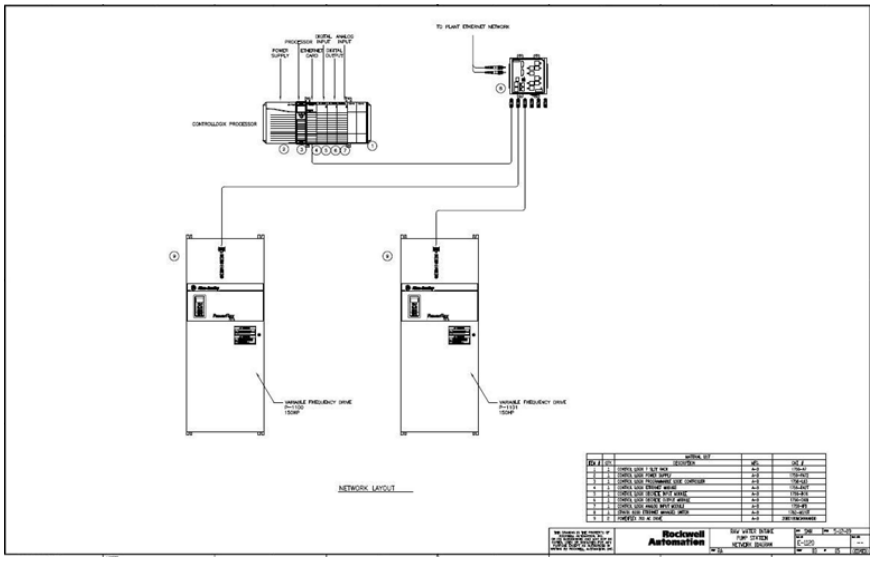
Raw Water Intake System Process Flow Diagram



Number	Title	Description
E-1110	System Process Flow Diagram	The flow diagram assumes a Raw Water Intake System with particular I/O. Any changes to the I/O for the Raw Water Intake System should be reflected on this diagram.

Network Diagram

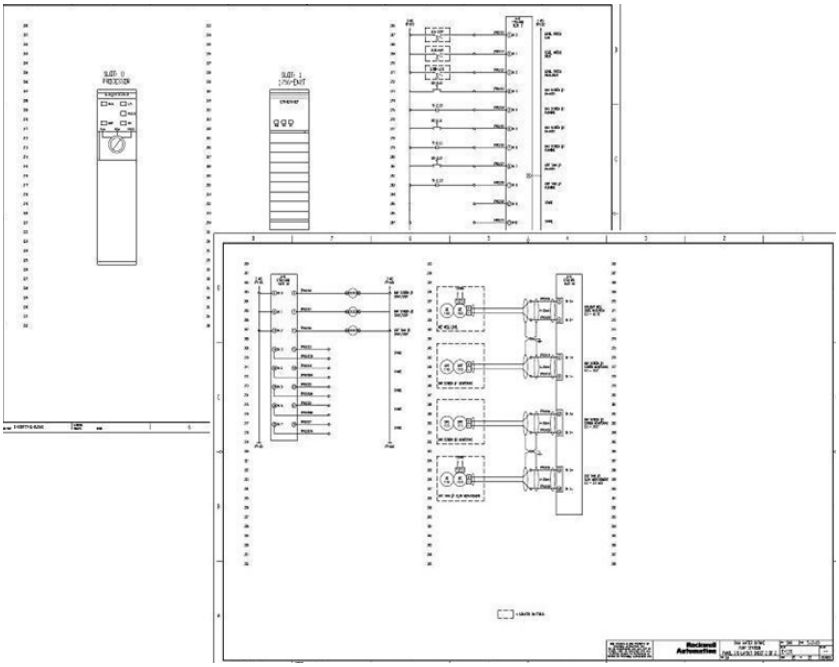
Raw Water Intake System Network Diagram



Number	Title	Description
E-1120	Network Diagram	For details, see page 23.

Panel I/O Layout Sheets

Raw Water Intake System Panel I/O Layout Sheets



Number	Title	Description
E-1130	Panel I/O Layout (Sheet 1 of 2)	This diagram depicts inputs and outputs to the controller. This format uses three cards per sheet. Inputs to the card are shown with the input device to the left of the input card. Output devices are shown to the right of the output card. You must add a new drawing sheet for every additional input or output card. This drawing package reserves space for all the "slots" of a controller's chassis. If an additional chassis is required, use this same format with space reserved in the drawings for any empty slots of the chassis. This provides a pre-determined location in the drawing package for all the I/O modules. I/O specific to an application are shown here and it is expected that these sheets are heavily modified for each application. These sheets provide a template for use for many applications though even if the specific I/O points vary. These sheets include digital input and output modules as well as analog input and output modules. This provides one example of each type of module that will typically be used in a Raw Water Intake System application. **Note:** This drawing depicts 1756 style I/O modules. If you use different I/O modules, you must also update these sheets.
E-1131	Panel I/O Layout (Sheet 2 of 2)	

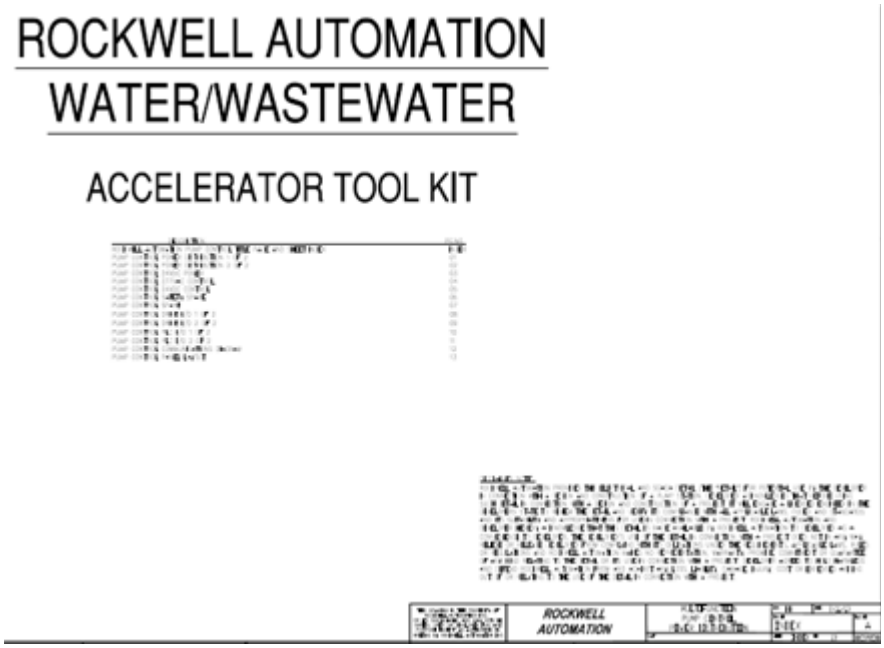
Pump Controller Station Hardware Drawings

One of the System Architecture sub-folders on the WWWAT CD is the Pump Controller Station folder and it contains the following drawings:

- Title Page and Sheet Index
- Communications Diagram
- Panel Layout Diagram
- Power Layout Sheets
- Panel I/O Layout Sheets

Title Page and Sheet Index

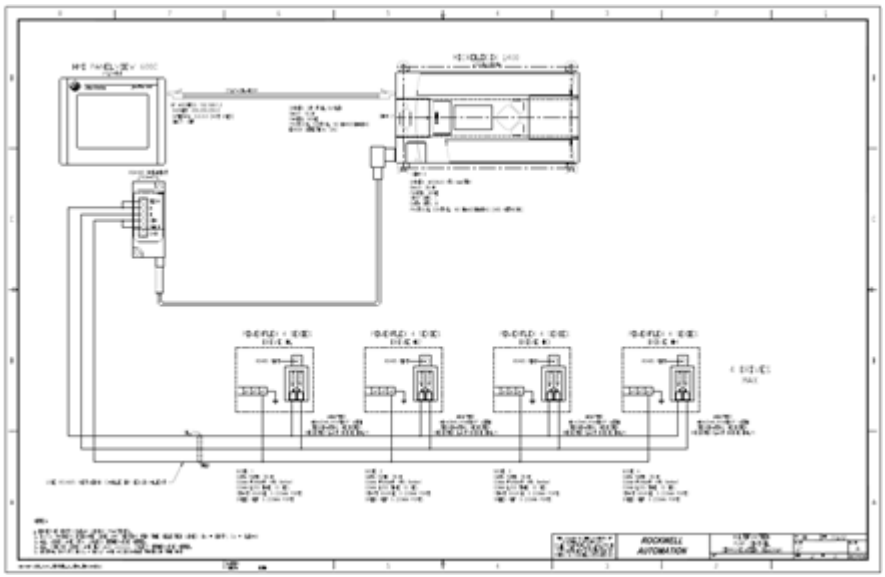
Pump Controller Station Title Page and Sheet Index



Number	Title	Description
Index	Title Page and Sheet Index	This is the Table of Contents/Cover Sheet for the drawing package. Modify this sheet as necessary to match the contents of the drawing package for your application.

Communications Diagram

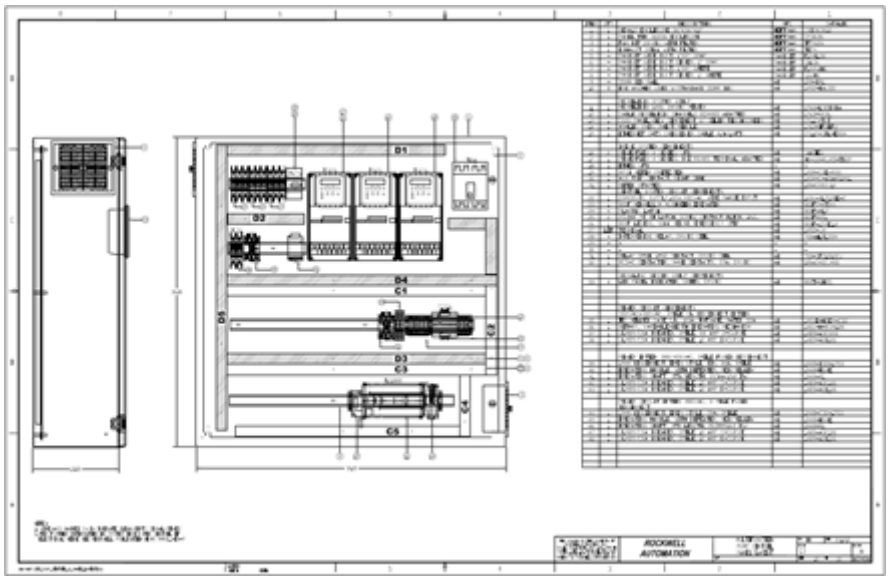
Pump Controller Station Communications Diagram



Number	Title	Description
E-12	Pump Control Communications Diagram	Refer to Pump Controller Station Architecture Drawing on page 28 for details.

Panel Layout Diagram

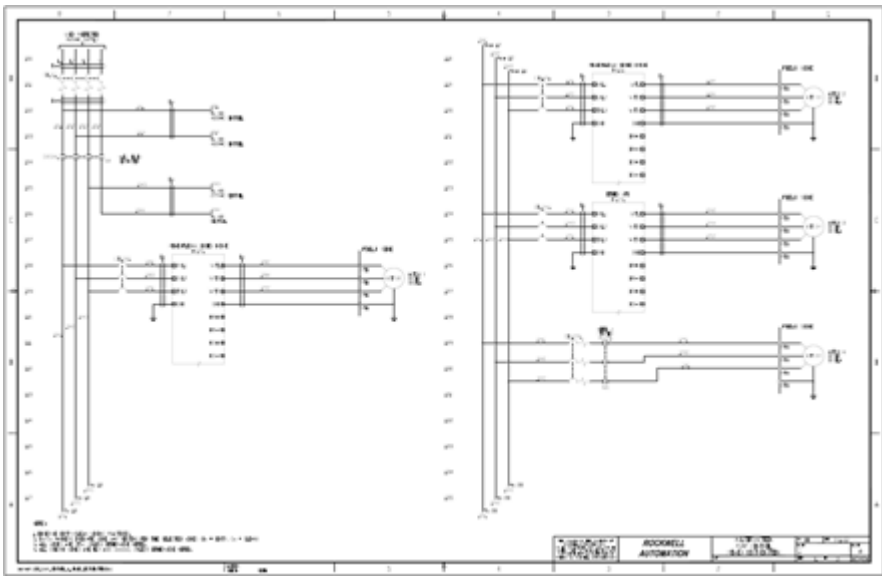
Pump Controller Station Panel Layout Diagram

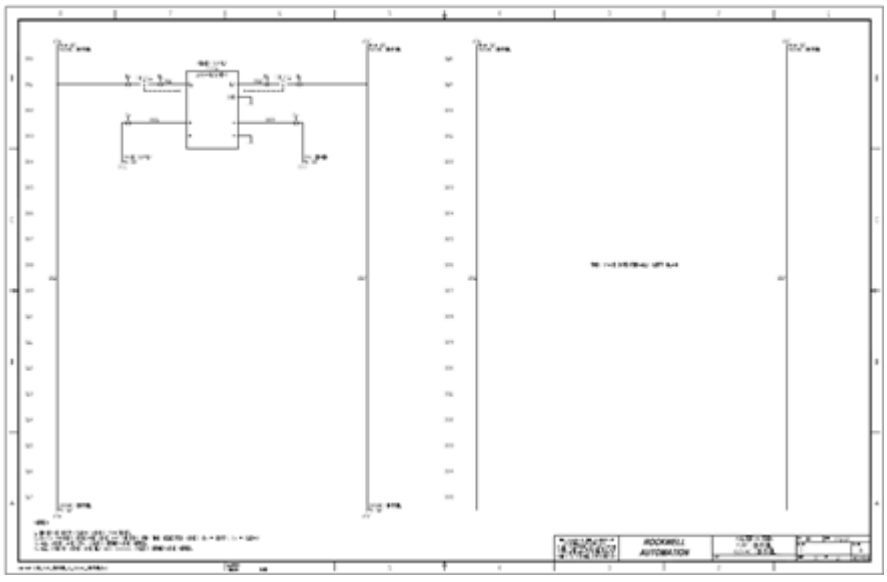


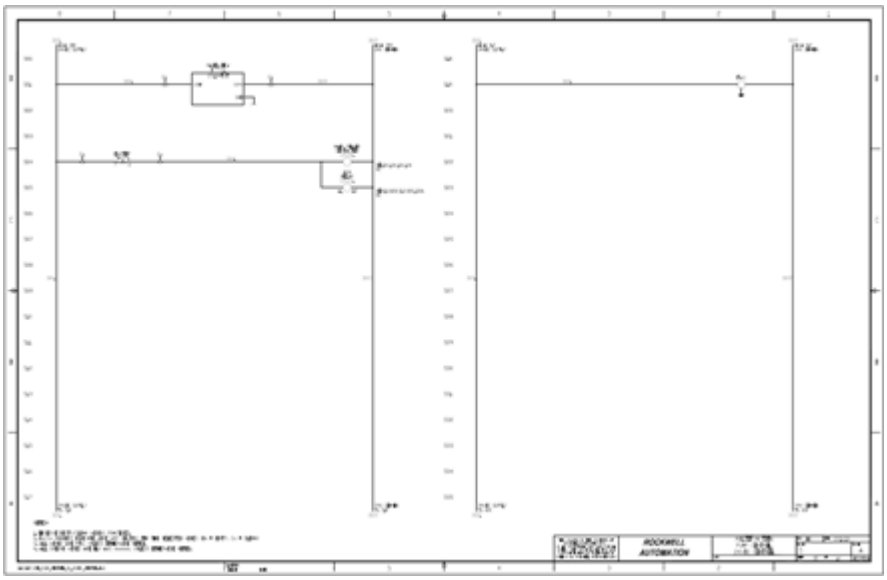
Number	Title	Description
13	Pump Controller Station Panel Layout Diagram	You can modify this as needed for your application requirements.

Power Layout Sheets

Pump Controller Station Power Layout Sheets



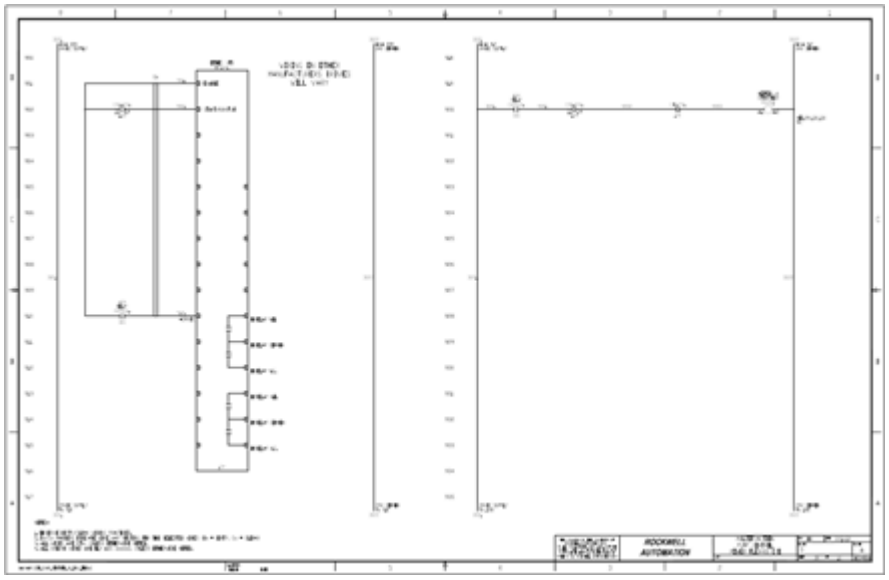


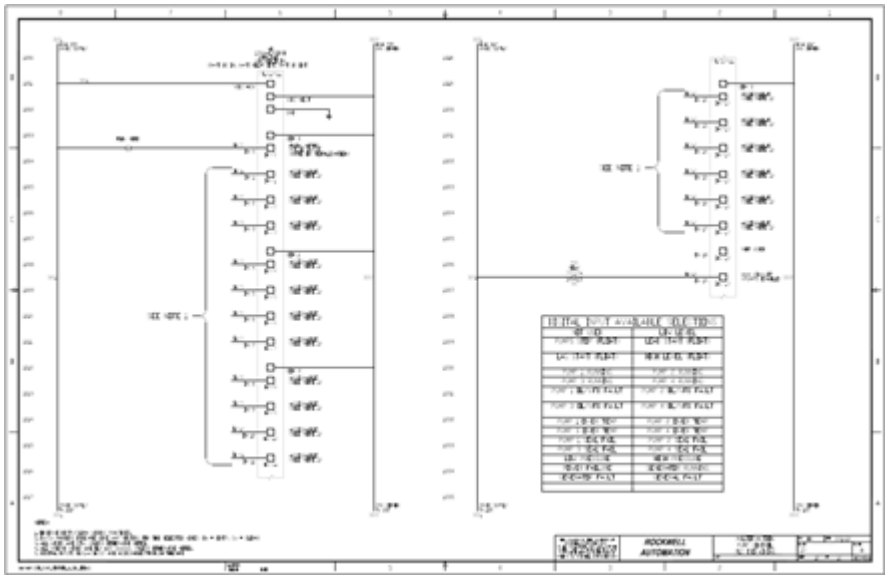


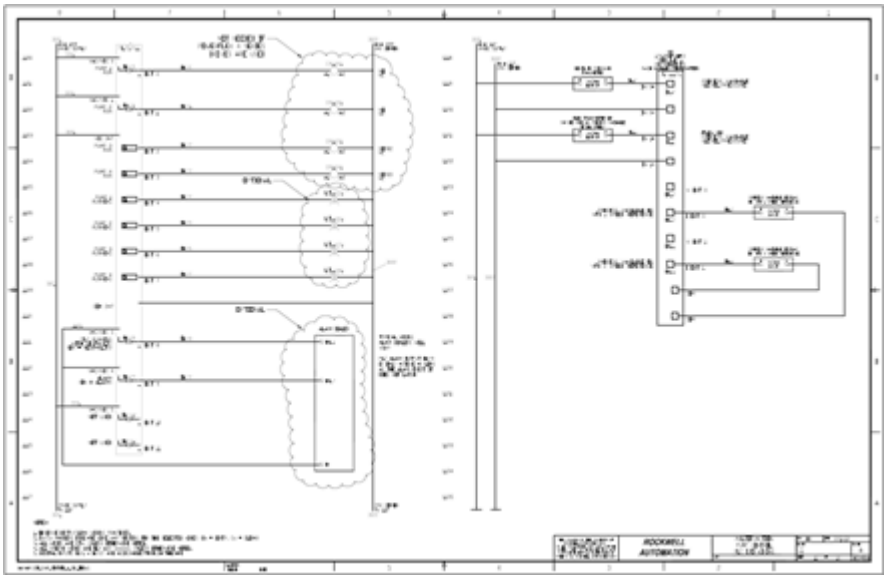
Number	Title	Description
1, 3 and 5	Power Layout Sheets	Pump Control Power Distribution, 480VAC Power, and 24VDC Power Drawings.

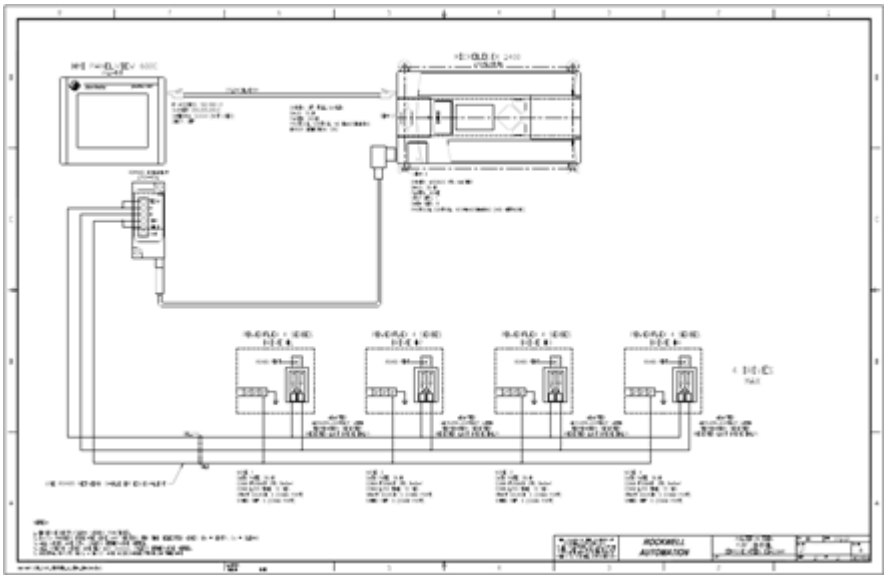
Panel I/O Layout Sheets

Pump Controller Station Panel I/O Layout Sheets







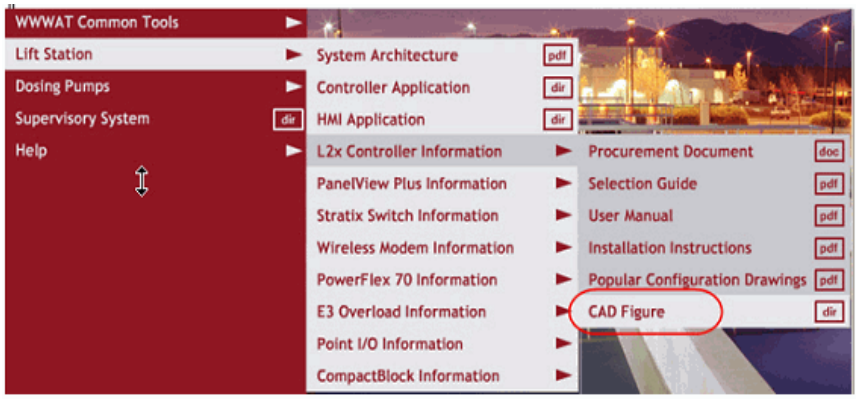


Number	Title	Description
8-11	I/O Layout Sheets	Pump Control Drive and PLC I/O Drawings.

CAD Figures

The WWWAT CD contains both AutoCAD® and Adobe® PDF formatted hardware template files that you can use when designing your application. Template files are available in .dwg, .dxf and .pdf file format.

Accessing the CAD Images from the WWWAT CD



The CAD files can be imported into your AutoCAD project for use in the development of drawing packages for your water and wastewater application.

Download additional CAD files from the Rockwell Automation Configuration and Selection Tools Website at http://www.rockwellautomation.com/en/e-tools/.

How to Access Additional CAD Figures from the Website

Use these steps to access the additional CAD figures from the Rockwell Automation website.

1. Go to http://www.rockwellautomation.com/en/e-tools/.
2. On the Product Selection tab, type the catalog number of the part you want, click on the product directory for additional information, or use the Product Configuration Assistant.

Additional Resources

To assist you in the hardware design phase of your water or wastewater project, the WWWAT CD contains links to numerous websites where you can find useful and up-to-date information. For more information on websites and documentation that will help you plan and design your Water and Wastewater project, see Appendix A.

Notes:

Application Engineering

Additional Resources

To assist you in the hardware design phase of your Water and Wastewater project, refer to the Water and Wastewater Accelerator Toolkit (WWWAT). This toolkit resides on a CD and contains links to numerous websites that contain useful and up-to-date information. Refer to the Preface for more information about the WWWAT.

For more information on websites and documentation that will help you plan and design your Water and Wastewater project, see Appendix A.

Process Library Module

The Process Library is a collection of RSLogix 5000 and FactoryTalk View SE component Add-On-Instructions (AOIs), also known as faceplates. Rockwell Automation developed these Faceplates to facilitate the efficient development of flexible and robust process systems. This library is included on the WWWAT CD along with the associated documentation (refer to the Preface's Introduction section for more information.

Selecting the Process Library

All systems share common components, although the precise functionality of individual process systems varies. For example, process systems typically include many of these hardware components:

- Digital Inputs/Outputs
- Analog Inputs/Outputs
- Single Speed Motors
- Variable Speed Drives
- Motor and Solenoid Operated Valves

You must develop code to manage the interface between the Controller and these devices. you must also create several of the following logical constructs to merge this collection of hardware into a cohesive system:

- Alarms
- Interlocks
- Permissives
- Rule Base Inhibits

The Process Library includes RSLogix 5000 AOIs for performing each of these tasks. In addition, the Library includes graphical objects for use in building a Visual Interface to your Controller. The combination of code and graphics ensures a visually and functionally consistent system.

The Process Library enables you to:

- Speed up development time and focus your energies on the custom aspects of your application.
- Increase quality by reusing well-tested code to reduce the likelihood of code bugs.
- Aids in producing well-structured code - in addition the standard graphics increases the consistency of your HMI thus reducing the need for operator training.
- Leverage scalability - build ever larger systems using the same reusable modules.

Using the Process Library Module

The Process Library is a collection of components that provide a large amount of flexibility. You can choose to use any number of the modules and it does not require you to code within a rigid structure. You also retain the flexibility of a Logix System, while saving yourself the trouble of writing and maintaining standard functionality.

The Process Library makes extensive use of AOIs, which are custom instructions that a user designs and creates. Using AOIs, you can create new commonly-used logic instruction sets, provide a common interface to this logic, and provide instruction documentation.

AOIs are intended to be used to encapsulate commonly used functions or device control. They are not intended to be a high-level hierarchical design tool. Programs with routines are better suited to contain code for the area or unit levels of your application. These are some benefits to using an AOI.

Reuse Code

AOIs promote consistency between projects by reusing commonly-used control algorithms. For algorithms that will be used multiple times in the same project or across multiple projects, it may make sense to incorporate that code inside an AOI to make it modular and easier to reuse.

Provide an Easier to Understand Interface

AOIs enable you to design a more user friendly interface by:

- Placing complicated algorithms inside of an AOI and marking the essential Parameters as visible or required.
- Reduce documentation development time through automatically generated instruction help.

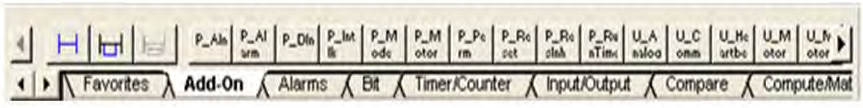
Intellectual Property Protection

An AOI enables you to insert Proprietary code inside it using source protection to prevent unauthorized users from viewing or changing your code. You can use AOIs across multiple projects. You can define the instructions, the instructions can be provided by someone else, or they can be copied from another project.

Once defined in a project, AOIs behave similarly to the built-in instructions already available in the RSLogix 5000 software. They appear on the instruction tool bar and in the instruction browser for easy access, just like built-in RSLogix 5000 software instructions.

This is an example of AOIs in the instruction tool bar.

AOI Instruction Tool bar



Using Add-On Instructions

This section lists the modules that exist in the Process Library and provides a brief functional description for each of them. Refer to each module's documentation for more detailed information. The Process Library section of the WWWAT CD contains separate documentation files for each of the modules. Refer to the Preface for more information about the WWWAT.

Alarm (P_Alarm)

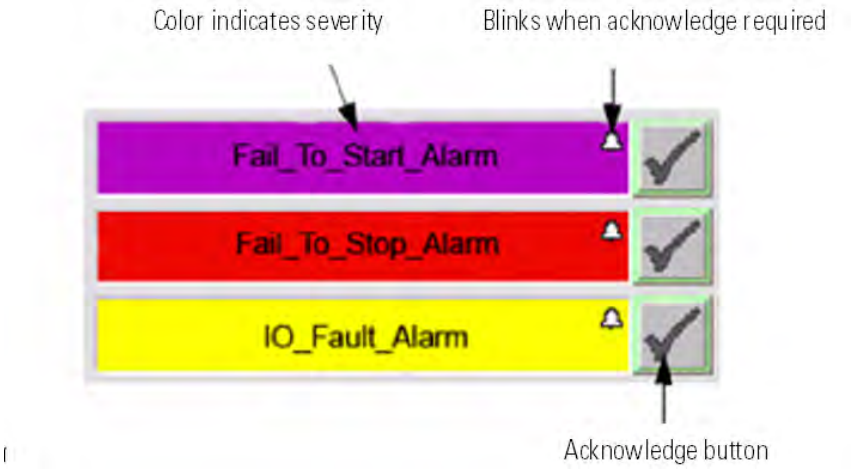
The following table describes the Alarm (P_Alarm) parameter and its usage.

Alarm (P_Alarm)

AOI	Description	Use This Instruction When	Do Not Use This Instruction When
Alarm (P_Alarm)	This instruction monitors an input condition and when it has been true for a specified time, initiates an alarm. It also monitors Alarm Acknowledgement, Alarm Reset, Alarm Inhibiting /Disabling, and Alarm Suppression (for FactoryTalk Alarm and Events).	• You want to develop your own AOIs and have it generate alarms that are compatible with the alarm setup for the Process AOIs. Use the P_Alarm instruction embedded within your AOI. • You have a condition in your logic (outside of any AOI) that you need to generate an Alarm. Use the P_Alarm instruction stand-alone within your program logic.	• You have a discrete input signal from a flow switch, pressure switch, level switch, or other device and want to display the device state, generate alarms, or condition the alarm based on time or gating signals. Use the P_Alarm (Alarm) or P_DIn (Discrete Input) AOI instead. • You need synchronized time stamping features or other FactoryTalk Alarm and Event features not supported by P_Alarm. Instead, use the ALMD built-in instruction.

Once the system initiates an alarm, the alarm displays change color according to their severity. A small bell appears in the upper right-hand corner of the display to indicate that an alarm is active. If you must acknowledge the alarm, this bell blinks.

Alarm AOI



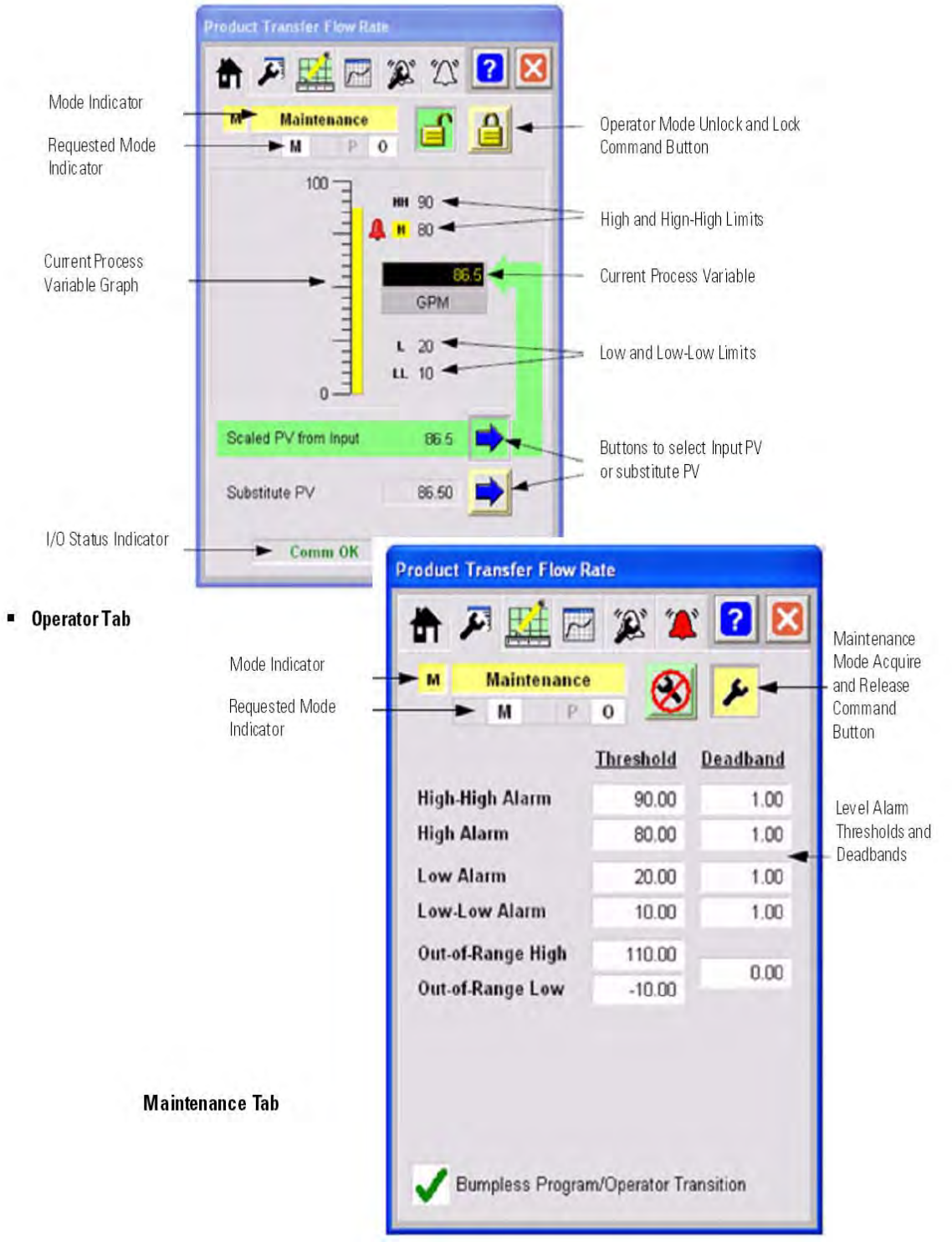
Analog Input basic Instruction (P_AIn)

The following table describes the Analog Input Basic Instruction (P_Aln) parameter and its usage.

Analog Input Basic Instruction (P_AIn)

AOI	Description	Use This Instruction When	Do Not Use This Instruction When
Analog Input (P_AIn)	This instruction monitors one analog value, typically from an analog input I/O module, and provide alarms when the analog value exceeds user-specified limits (high and low). The Analog Input Instruction also provides capabilities for linear scaling of an analog input value from "raw" (input) units to "engineering" (output) units, and entry of a Substitute Process Variable provides handling of an out-of-range or faulted input. To keep the Instruction memory and execution footprint small, certain capabilities, used less frequently, are reserved for the Advanced Analog Input AOI.	• You want to display a temperature, flow, pressure, level, or another signal from a field instrument on your HMI. • You need any of the Scaling, Alarming, or HMI features for an Analog Input, or any Analog (quantity) value. • You want Linear scaling from Raw to Engineering Units. • You need High, Low, High-High, Low-Low, and Out of Range alarms (with dead band and delay per alarm). • You use an indicator graphic object with label and engineering units. • You use a faceplate with mode selection, alarm limit entry, and maintenance capability for substitute PV.	• The analog input signal works with another instruction. For example, the Speed Feedback for a variable speed drive is completely handled by the P_VSD Instruction. It is not necessary to use the P_AIn instruction first. Wire or map the input directly to P_VSD. • You only need to display a number on a screen and do not need any of the scaling or alarming features. (Just use a numeric display field.) • You need advanced capabilities such as square root extraction (for example, orifice flow meters), rate-of-change alarming or limiting, or alarming for deviation from a reference value. Use the P_AInAdv (Advanced Analog Input) Instruction instead. • You have the dual sensors for one process variable (such as dual pH meters) and need to select one or the other sensor (or their average). Use the P_AInDual (Dual Analog Input) Instruction instead.

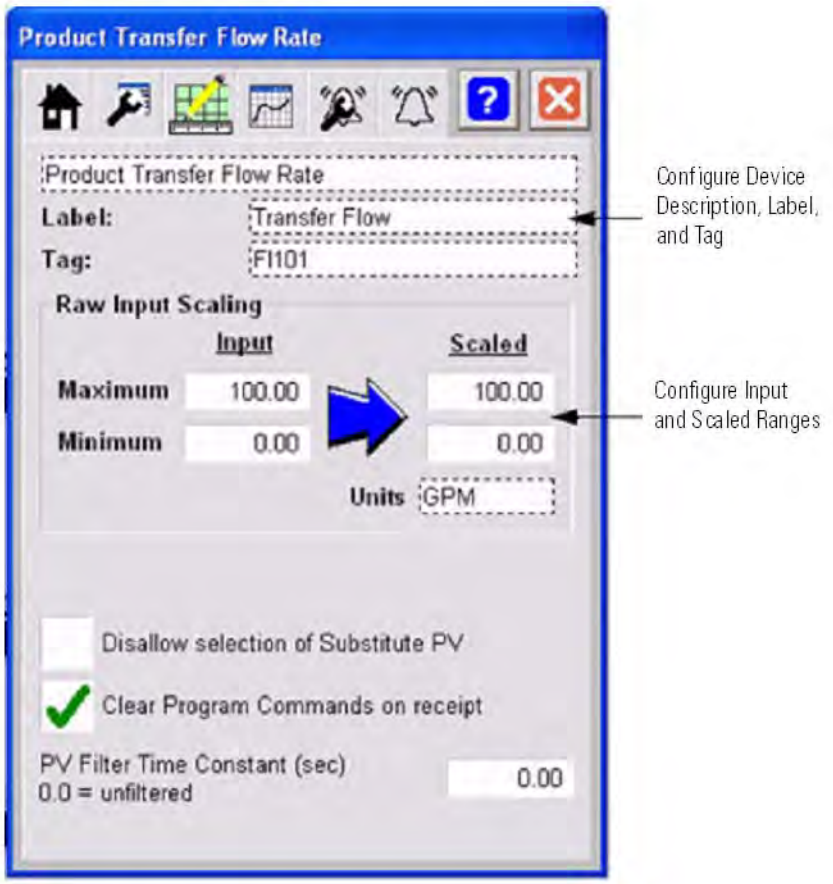
Analog Input (P_AIn) Process Variable Faceplate



- **Operator Tab**

Maintenance Tab

Analog Input (P_AIn) Engineering Tab Faceplate



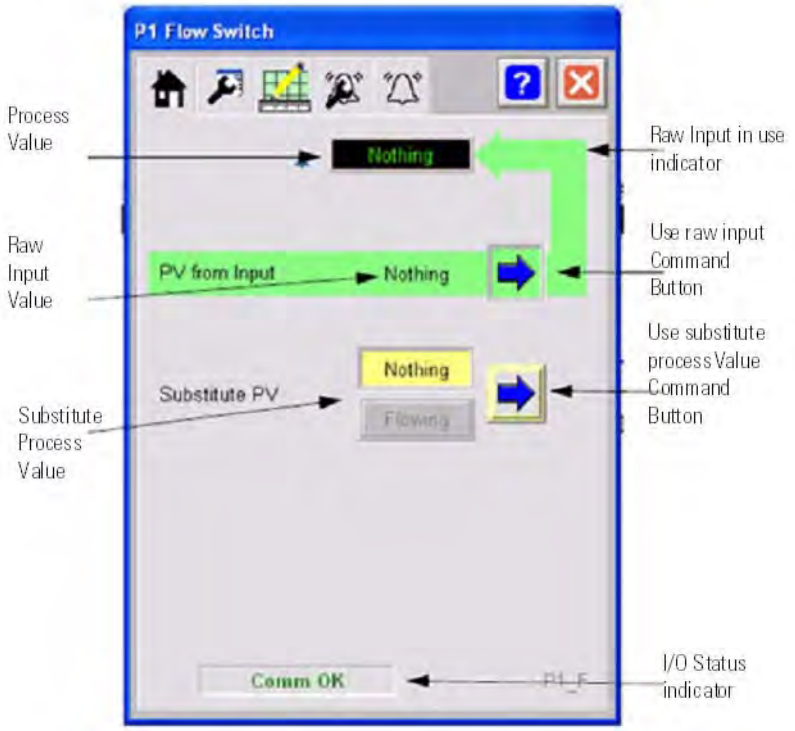
Digital Input Instruction (P_DIn)

The following table describes the Digital Input Instruction (P_Dln) parameter and its usage.

Digital Input Instruction (P_DIn)

AOI	Description	Use This Instruction When	Do Not Use This Instruction When
Digital Input (P_DIn)	This AOI receives and processes a single discrete condition (bit or PV), typically for a channel of a discrete input card. It can be used with any discrete (BOOL) signal. The P_Dln AOI includes the capability to generate a discrete input alarm, such as from a low level switch, high vibration switch, or flow switch.·	• You want to display the state of a process temperature, level, flow, proximity, pressure, or other switch. • You need any of these signal processing or alarming features for a discrete input or any discrete (bit) value. • You require debounce of a Discrete Input signal. • You want the system to activate an alarm when the Discrete Input is not in a target state for some period of time. • You want the system to enable an alarm when a gating condition is true for some period of time. • You want the system to display the switch state with configurable text on an HMI object with operator Faceplate call-up. • You need Maintenance to be able to provide a substitute value when the device has failed.	• You need only to show or not show the state of a bit on an HMI display. Use basic display objects (text, multi-state indicators) with appropriate animation instead. • You need only to generate an alarm from some condition you already have in your code. Use the P_Alarm AOI or the ALMD built-in instruction instead.

Digital Input (P_Din) Faceplate



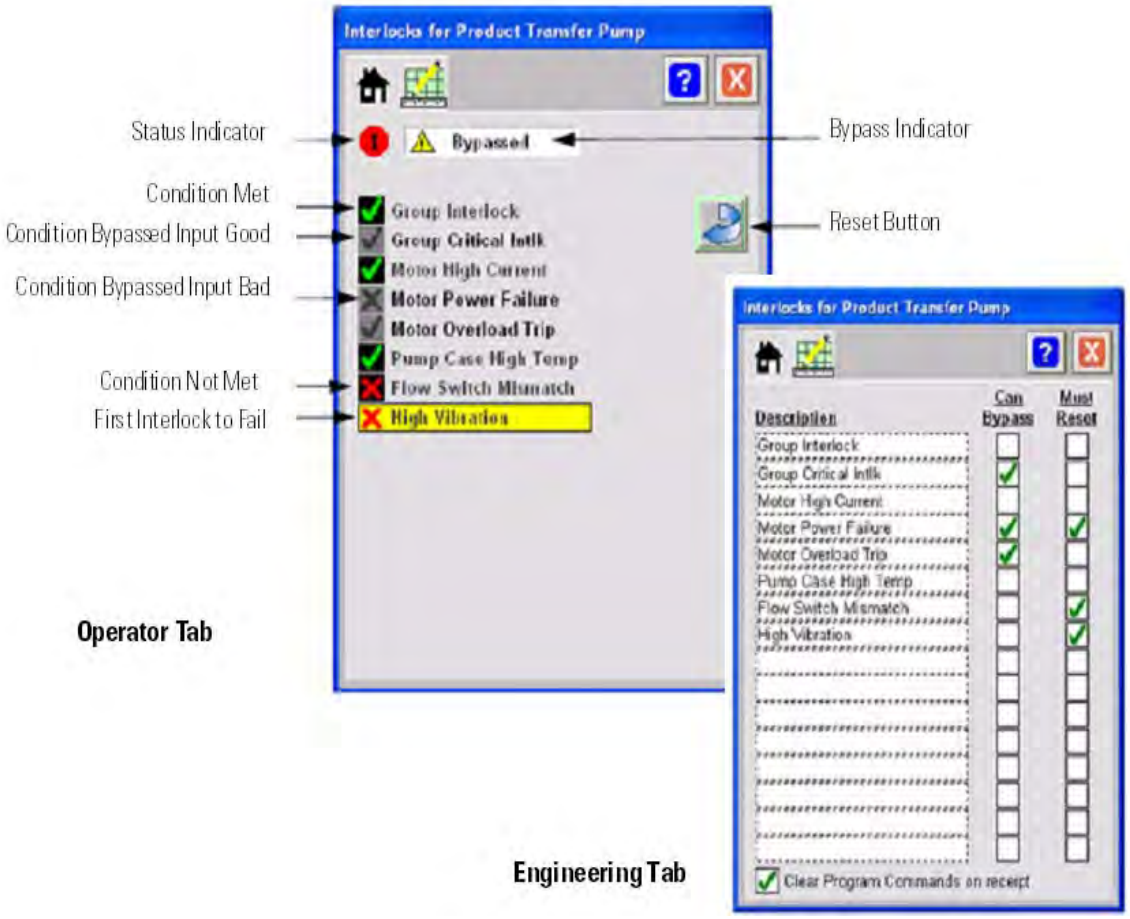
Interlock Instruction (P_Intlk)

The following table describes the Interlock Instruction (P_Intlk) parameter and its usage.

Interlock Instruction (P_Intlk)

AOI	Description	Use This Instruction When	Do Not Use This Instruction When
Interlock (P_Intlk)	This AOI collects ("sums up") the Interlock conditions which stop a running (energized, open) piece of equipment or prevent it from starting. Interlocks are always evaluated to de-energize equipment. For "permissive" conditions, such as those that must be made to start the equipment but which are ignored once the equipment is running, use the P_Perm (Permissives) AOI.	• You have multiple interlock conditions or cascaded interlock conditions (an interlock hierarchy) which stop some equipment (motor, valve, drive) or keep it from starting. Link the P_Intlk Status bits to the Inp_IntlkOK and Inp_NBIntlkOK inputs of the motor, valve, or drive. • You need a first-out indication of which interlock condition shut down the equipment. • You want configurable text descriptions of shutdown conditions and other features of the P_Intlk Faceplates.	• You have conditions that prevent starting equipment, but which are ignored once the equipment is running. Those are permissive, not interlock conditions. Use the P_Perm AOI instead. • You have only one interlock condition for the equipment. Connect the condition directly to the interlock input on the device.

Interlock (P_Intlk) Faceplate



Mode (P_Mode)

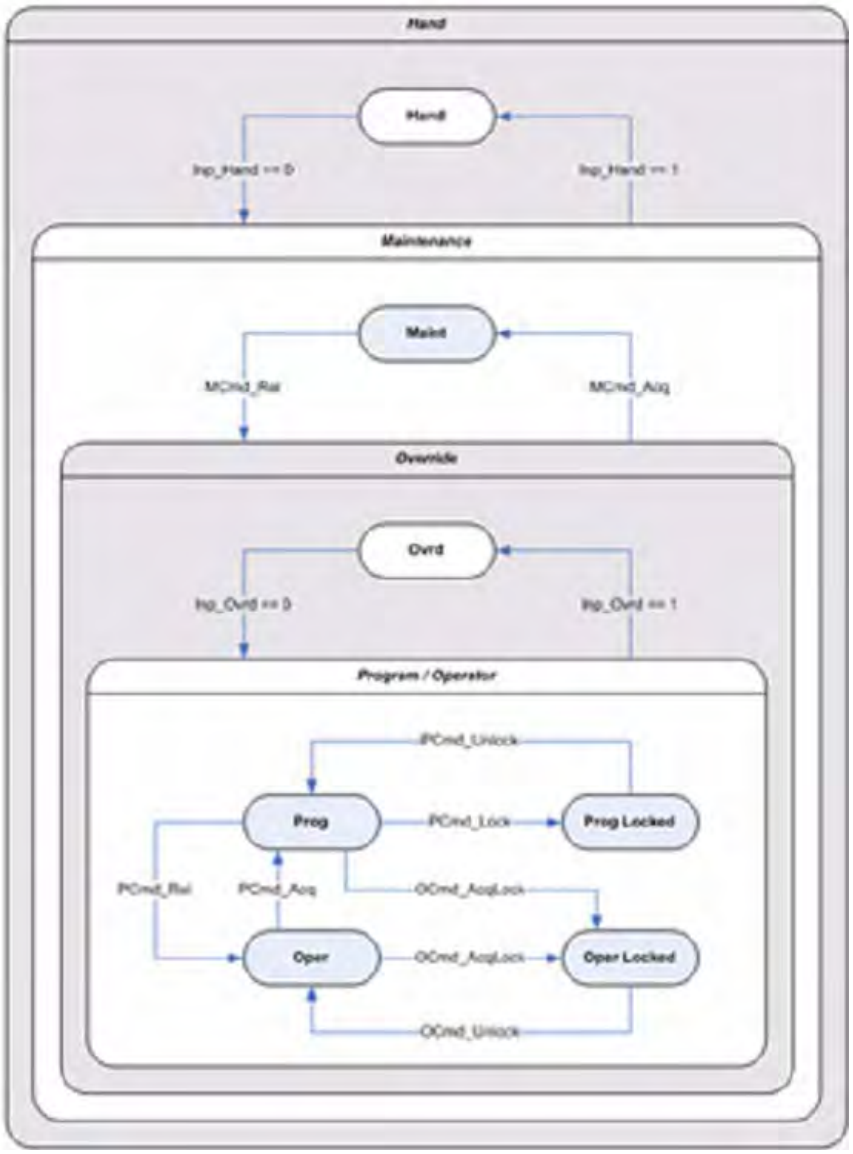
The following table describes the Mode (P_Mode) parameter and its usage.

Mode (P_Mode)

AOI	Description	Use This Instruction When	Do Not Use This Instruction When

Mode (P_Mode)	This AOI provides selection of the Mode (owner) of an instruction or control strategy. The Mode instruction is usually embedded within other instructions to extend their functionality. It is possible to use a stand-alone Mode instruction to enhance a program where modes are wanted.	• Creating an AOI for a device which:
		  • Requires separate acquisition by an operator and Program logic
		  • Supports Override or Hand capabilities
		  • Needs a separate Maintenance Mode
		Embed the P_Mode instruction within your AOI.
		
		• Creating a Control Strategy and you want standard arbitration between operator and Program modes (and perhaps Override, Maintenance, or Hand modes).
		
		Use the P_Mode instruction stand-alone within your strategy and condition Commands and Actions in the strategy on the P_Mode AOI mode Status bits.
			• Creating an AOI which does not do anything differently for:
			  • operators versus Program logic
			  • Override or Hand conditions
			  • Maintenance users.
			You do not need Modes or the P_Mode instruction.
			
			• Creating a complex strategy for shared equipment (Shared Use Common Resource) which has complex rules for arbitration and allocation of the equipment. You need rule-based sharing logic beyond the capabilities of the P_Mode instruction.

Mode Explanation Diagram



The modes have the following priority (also shown in the illustration above):

1. Hand (highest)
2. Maintenance
3. Override
4. Operator and Program (lowest)

The AOI still processes and retains the lesser priority mode requests, but the resultant mode is that of the highest priority request.

Selecting Modes

This table shows how to request, verify, and release a mode. It also shows the trigger input cycle.

Mode	Request (Input)	Acquired (Output	Release (Input)
Hand	Inp_Hand=1(level)	Sts_Hand=1	Inp_Hand=0 (level)
Maintenance	MCmd_Acq=1(edge)	Sts_Maint=1	MCmdRel=1(edge)
Override	Inp_Ovrd=1(level)	Sts_Ovrd=1	Inp_Ovrd=0(level)
Operator	OCmd_AcqLock=1	Sts_Oper=1	OCmd_UnLock=1
Program	See Program Mode	See Program Mode	See Program Mode

Program Mode

The Program Command functionality depends on the configuration for clearing Program Commands (Cfg_PCmdClear).

Mode	Option	Command	Description
Program	Cfg_PCmdClear=1	PCmd_Acq=1 (edge) PCmd_Rel=1 (edge) PCmd_Lock=1 (edge) PCmd_Unlock=1 (edge)	Request Program Mode Release Program Mode Lock Program Mode Unlock Program Mode
	Cfg_PCmdClear=0	PCmd_Acq=1 (level) PCmd_Acq=0 (level) PCmd_Lock=1 (level) PCmd_Lock=0 (level)	Request Program Mode Release Program Mode Lock Program Mode Unlock Program Mode

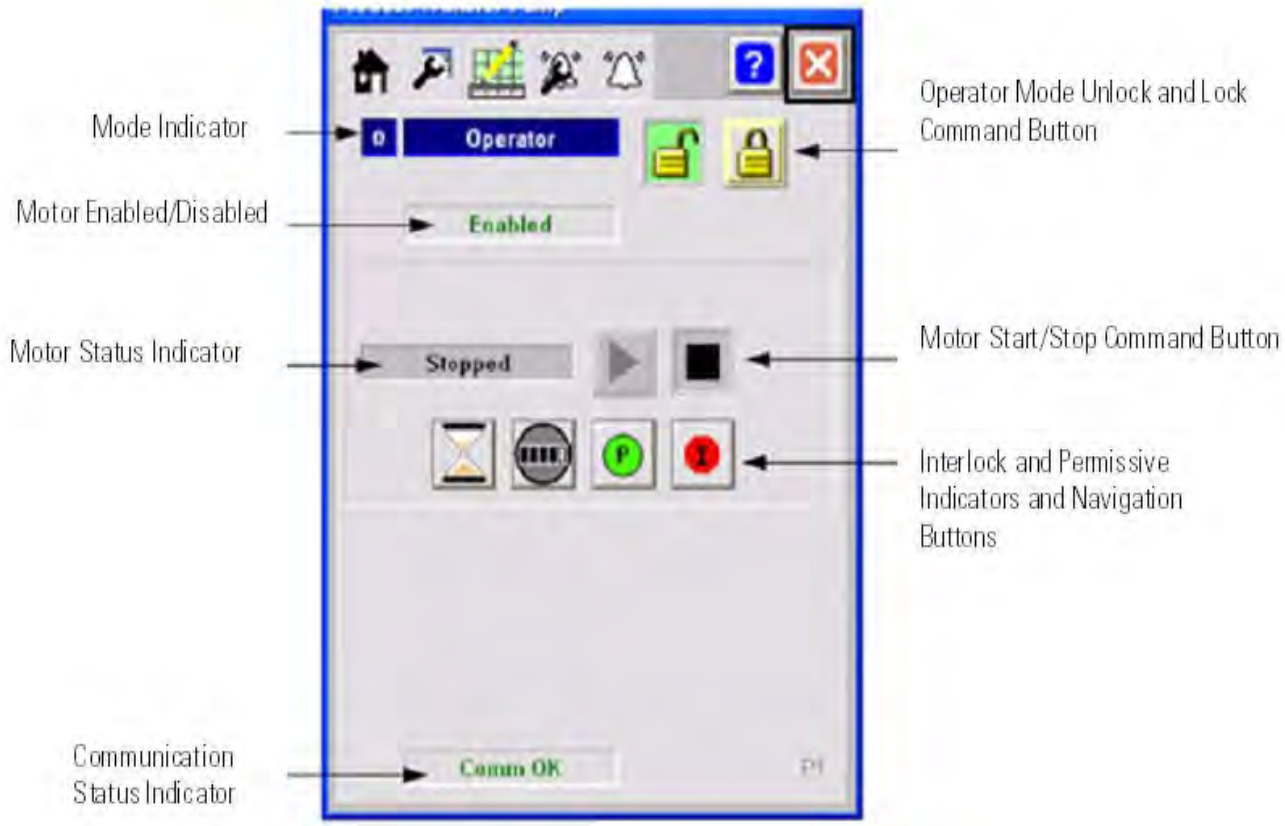
Motor (P_Motor)

The following table describes the Motor (P_Motor) parameter and its usage.

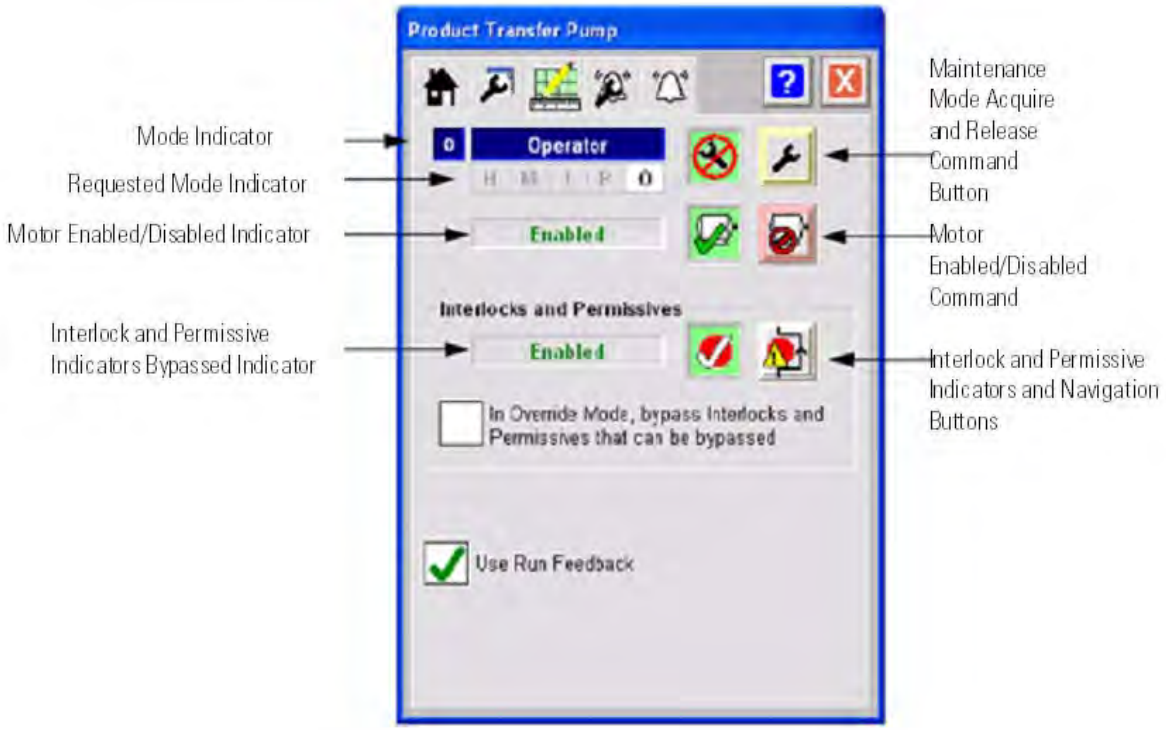
Motor (P_Motor)

AOI	Description	Use This Instruction When	Do Not Use This Instruction When
Motor (P_Motor)	The P_Motor (single speed motor) object controls a non-reversing, single speed motor in a variety of modes and monitors for fault conditions.	• You want to control a single-speed (running or stopped) motor. The motor can use a full voltage starter (FVNR), a soft starter or other motor protective equipment. However, it might provide run feedback. The P_Motor AOI provides Faceplates and graphic symbols for the operator display, control and appropriate modes/alarms.	• You want to control a two-speed (fast/slow/stopped) motor. Use the P_Motor2Spd (two speed motor) AOI instead. • You want to control a reversing (forward/stopped/reverse) motor. Use the P_MotorRev Reverse Motor) AOI instead. • You want to control a motor with continuously-varying speed. Use the P_VSD (Variable Speed Drive) AOI instead. • You want to control a motor that is part of a valve actuator. Use the P_ValveMO (Motor-Operated Valve) AOI instead.

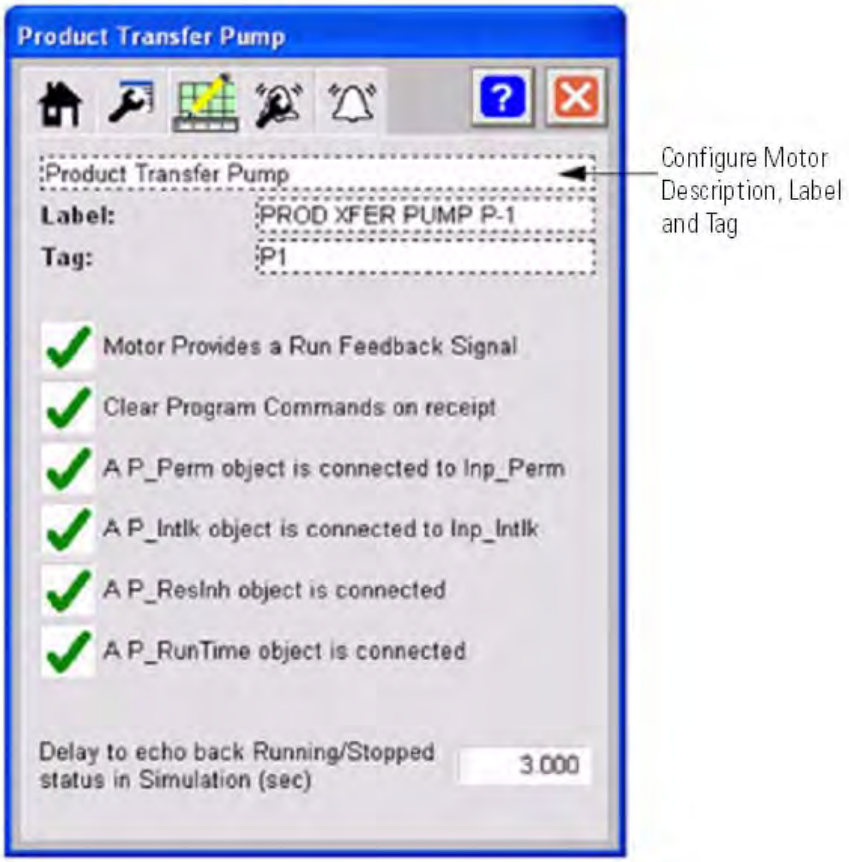
Motor (P_Motor) Operator Tab Process Variable Faceplate



Motor (P_Motor) Maintenance Tab Process Variable Faceplate



Motor (P_Motor) Engineering Tab Process Variable Faceplate


Product Transfer Pump
Product Transfer Pump
Label:
PROD XFER PUMP P-1
Tag:
P1
Motor Provides a Run Feedback Signal
Clear Program Commands on receipt
A P_Perm object is connected to Inp_Perm
A P_Intlk object is connected to Inp_Intlk
A P_ResInh object is connected
A P_RunTime object is connected
Delay to echo back Running/Stopped status in Simulation (sec)
3.000
Configure Motor Description, Label and Tag

Permissive (P_Perm)

The following table describes the Permissive (P_Perm) parameter and its usage.

Permissive (P_Perm)

AOI	Description	Use This Instruction When	Do Not Use This Instruction When
Permissive (P_Perm)	This AOI collects ("sums up") the Permissive conditions which allow a piece of equipment to start (run, energize, open, etc.). Permissive conditions generally must only be true to start the equipment. Once the equipment is running, Permissives are ignored. Use the P_Intlk (Interlocks) AOI for collecting conditions which stop running equipment as well as prevent it from starting.	• You have multiple or cascaded Permissive conditions which prevent some equipment (motor, valve, and drive) from starting, but which are ignored once the equipment is running. Link the P_Perm Status bits to the Inp_PermOK and Inp_NBPermOK inputs of the motor, valve, or drive. • You want configurable text descriptions of the Permissive conditions and other features of the P_Perm Faceplates.	• You have conditions that shut down running equipment as well as prevent it from starting. These are interlock, not Permissive conditions. Use the P_Intlk Instruction instead. • You have only one Permissive condition for the equipment - connect the condition directly to the permissive input on the device.

Reset (P_Reset)

The following table describes the Reset (P_Reset) parameter and its usage.

Reset (P_Reset)

AOI	Description	Use This Instruction When	Do Not Use This Instruction When
Reset (P_Reset)	This AOI provides a central point at which to reset equipment faults and latched alarms for a control strategy. The P_Reset accepts an Operator Reset Command, a Program Reset Command, and a Reset Input. These commands are initiated from a button input, higher-level P_Reset AOI (from a containing control strategy, say a Unit Reset sent to a P_Reset at Equipment Module scope), or from any other source. The Reset AOI also includes a "Reset Required" input for collecting the "Ready to Reset" outputs of the various instructions it resets and providing a "ready to reset" ("reset required") status which can illuminate a button or make an HMI reset button visible. The Reset AOI includes a timer function which causes its output to be held on for at least a minimum time. This allows the reset signal to be sent via physical output cards to field devices that may required it (e.g., motor drives) and gives time for the cleared status from the device to propagate back to an Interlock or Permissive inputs to the system.	• You want a common reset point ("Master Reset") for alarms and fault conditions for a control strategy, process unit, process cell or equipment group, process area or plant section, or even a small site. Tie the output of the P_Reset instruction to the Inp_Reset input of the equipment to be reset. • You want a cascading reset strategy, where there is a P_Reset instruction for a small equipment scope such as a strategy which incorporates resets from wider scope (unit, cell, area, site) resets. Tie the output of the higher-level P_Reset instruction to the Inp_Reset input of the lower-level P_Reset instruction.	• You want to reset a single piece of equipment (valve, motor). Use the Operator or Program Reset Command directly on the equipment.

Reset Inhibit (P_ResetInh)

The following table describes the Reset Inhibit (P_ResetInh) parameter and its usage.

Reset Inhibit (P_ResetInh)

AOI	Description	Use This Instruction When	Do Not Use This Instruction When
Reset Inhibit (P_ResetInh)	This AOI prevents damage to a large motor through repeated starts. The high starting current for a large motor causes considerable heating. Because the thermal mass of a large motor is much smaller relative to its horsepower and starting current compared to smaller motors, repeated starts (or start attempts) over a short time will overheat the motor windings, potentially damaging the motor permanently. The Restart Inhibit AOI provides a rule-based state model for restarts and is NOT intended to model or monitor the motor heating. It cannot replace sensor-based motor monitoring systems. It can, however, be a simple solution to avoid overstressing a motor without the cost (money or Controller resources) of more extensive modeling and monitoring.	• You have a large motor or other piece of equipment where repeated start/stop cycles or failures to start may damage the equipment. • The state model of the P_ResInh instruction is appropriate for limiting the restarts of the equipment ("Three Starts" rule, hot/cold model, etc.). • You don't have the sensors or equipment for more advanced motor monitoring or modeling.	• You have more advanced motor monitoring equipment or motor heating models available. Use the advanced equipment to provide a start permissive instead. • You have a small motor that can repeatedly start and stop without damage, or a simple thermal cutout provided with the motor is sufficient to protect it.

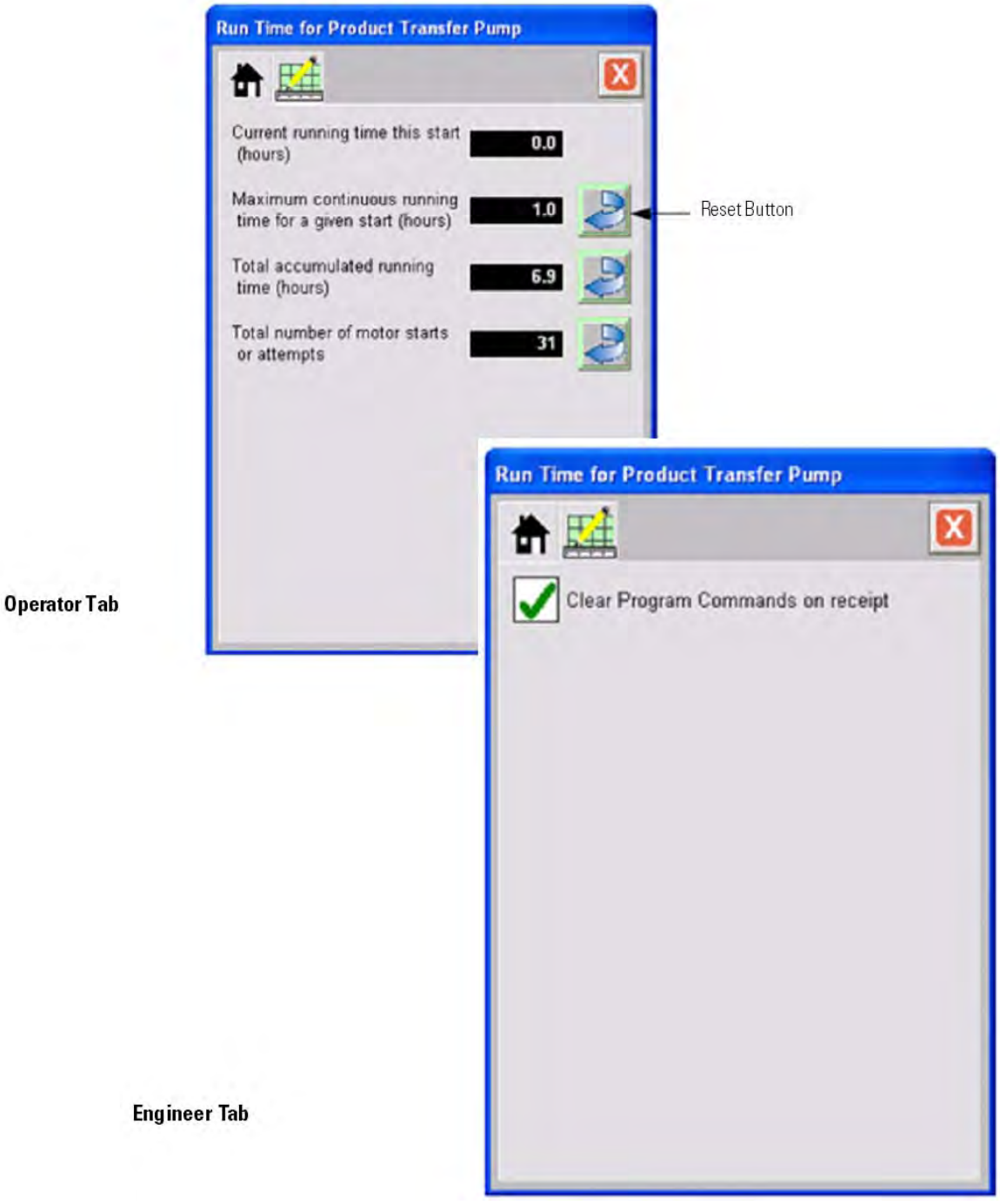
Run Time (P_RunTime)

The following table describes the Run Time (P_RunTime) parameter and its usage.

Run Time (P_RunTime)

AOI	Description	Use This Instruction When	Do Not Use This Instruction When
Runtime (P_RunTime)	This AOI is used to accumulate the total run time and count of starts for a motor or other equipment. It is a software implementation of the mechanical "hour meter" that is often mounted in the door of a motor control center (MCC) bucket to show total motor run time. The time and number of starts are variables used by maintenance personnel to determine when to perform maintenance activities on motor or other equipment.	• You want the functionality of a run time meter or start counter without having to add hardware devices for these functions to your Motor Control Center. • You need the total run time, current run time, maximum run time or start count information for a piece of equipment on the operator display and you do not have monitoring software that provides the information. • Your equipment monitoring software expects the Controller to provide equipment run time and starts values rather than just a Running status.	• You have advanced software for monitoring equipment run time that only needs the equipment running status as its input.

Run Time (P_RunTime) Process Variable Faceplates



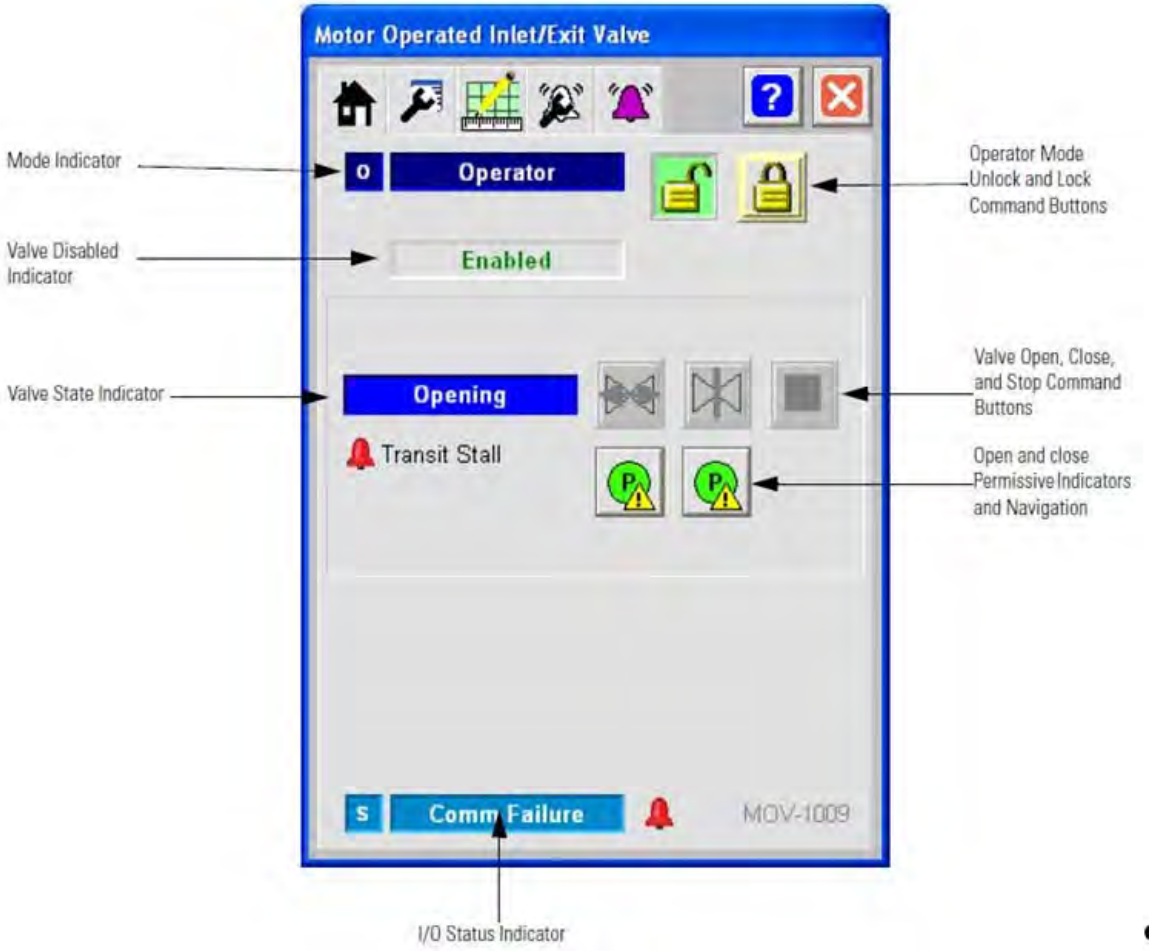
Motor Operated Valve (P_ValveMO)

The following table describes the Motor Operated Valve (P_ValveMO) parameter and its usage.

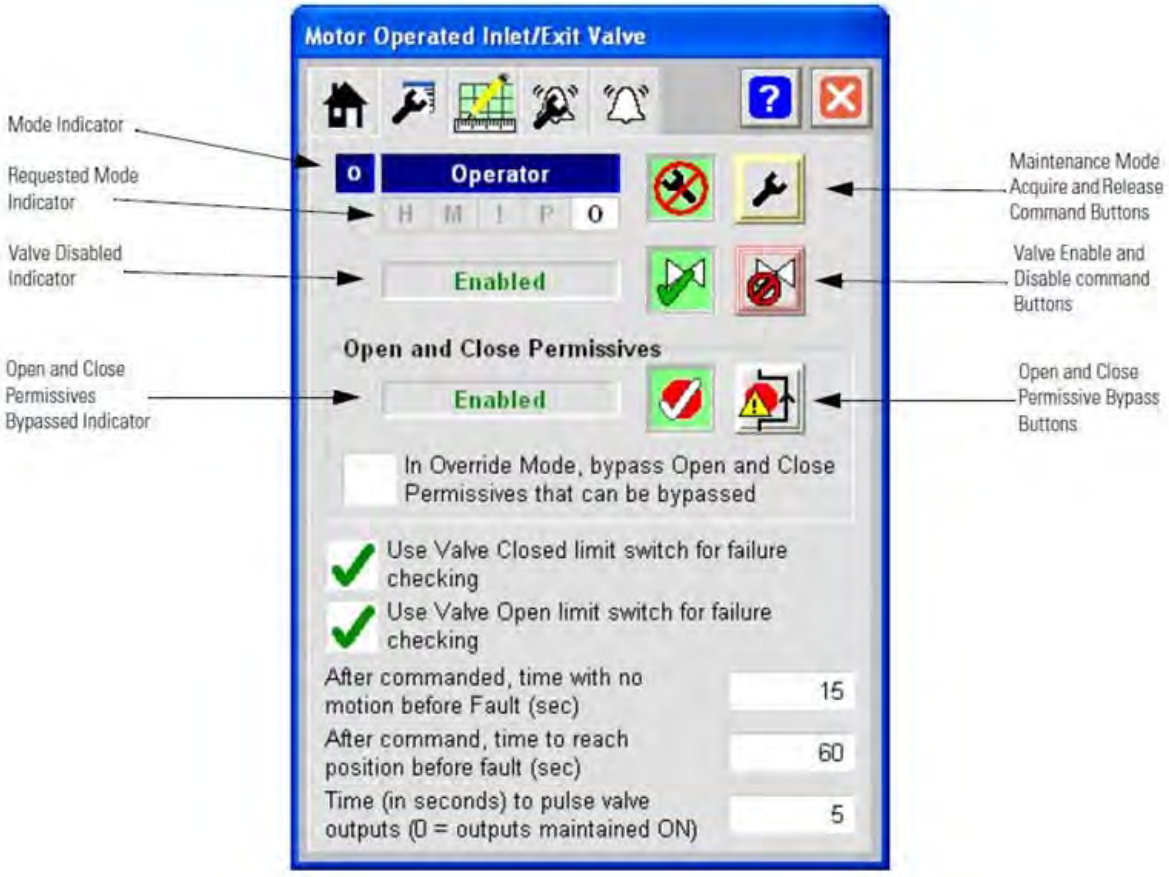
Motor Operated Valve (P_ValveMO)

AOI	Description	Use This Instruction When	Do Not Use This Instruction When
Variable Speed Drive (P_ValveMo)	This AOI operates (open and close) a motor-operated valve in a variety of modes (see below), monitoring for fault conditions.	• To use a motor-operated valve or other valve that requires separate open and close outputs. This valve may use limit switch feedback for the ends of travel. The valve may also require an output to trigger a "valve stop" function, such as breaking a seal-in circuit on the valve operator to stop travel or switch the direction of travel.	• You need to operate a single-solenoid spring-return valve (fail closed or fail open). Use the P_ValveSO Solenoid-Operated Valve AOI instead. • You need to operate a multi-solenoid valve such as a Mix-Proof Valve that has positions (such as CIP) other than "opened" and "closed." You will need specific Mix-Proof Valve logic. (A Mix-Proof Valve Add-On Instruction may be added in the future.) • You need to monitor a valve that is primarily operated by hand. The valve could support a "trip" output to drive it to a "safe" position. Use the P_ValveHO Hand-Operated Valve Add-On Instruction instead.

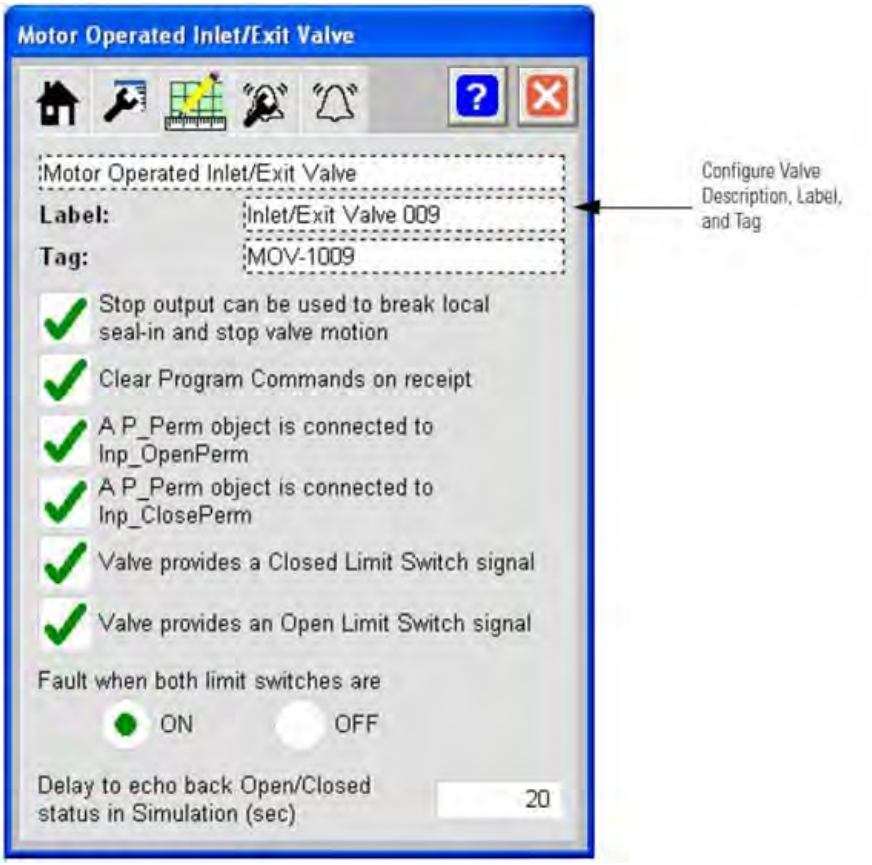
Motor Operated Valve (P_ValveMO) Operator Tab Process Variable Faceplate



Motor Operated Valve (P_ValveMO) Maintenance Tab Process Variable Faceplate


Motor Operated Inlet/Exit Valve
Mode Indicator
Requested Mode Indicator
Valve Disabled Indicator
Open and Close Permissives Bypassed Indicator
Maintenance Mode Acquire and Release Command Buttons
Valve Enable and Disable command Buttons
Open and Close Permissive Bypass Buttons
O
Operator
H M I P O
Enabled
Open and Close Permissives
Enabled
In Override Mode, bypass Open and Close Permissives that can be bypassed
Use Valve Closed limit switch for failure checking
Use Valve Open limit switch for failure checking
After commanded, time with no motion before Fault (sec)
15
After command, time to reach position before fault (sec)
60
Time (in seconds) to pulse valve outputs (0 = outputs maintained ON)
5

Motor Operated Valve (P_ValveMO) Engineering Tab Process Variable Faceplate


Motor Operated Inlet/Exit Valve
Motor Operated Inlet/Exit Valve
Label:
Inlet/Exit Valve 009
Tag:
MOV-1009
Stop output can be used to break local seal-in and stop valve motion
Clear Program Commands on receipt
A P_Perm object is connected to Inp_OpenPerm
A P_Perm object is connected to Inp_ClosePerm
Valve provides a Closed Limit Switch signal
Valve provides an Open Limit Switch signal
Fault when both limit switches are
ON
OFF
Delay to echo back Open/Closed status in Simulation (sec)
20
Configure Valve Description, Label, and Tag

Variable Speed Drive (P_VSD)

The following table describes the Variable Speed Drive (P_VSD) parameter and its usage.

Variable Speed Drive (P_VSD)

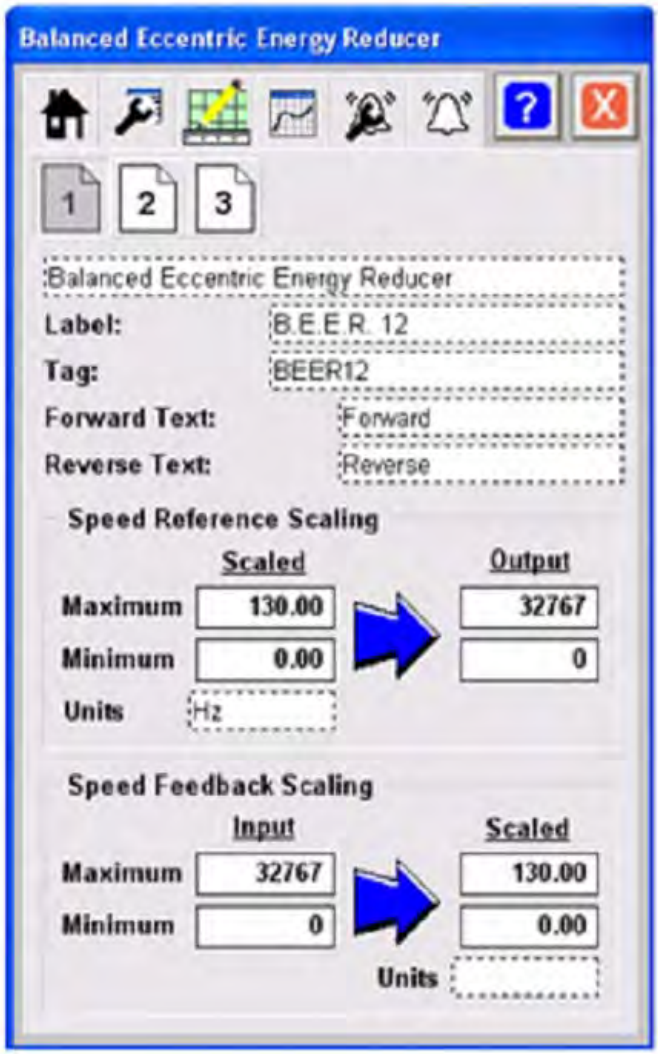
AOI	Description	Use This Instruction When	Do Not Use This Instruction When
Variable Speed Drive (P_VSD)	This AOI is used to operate one variable speed motor using a Drive (AC variable frequency or DC) in a variety of Modes, monitoring for fault conditions.	• You need to operate a motor connected to a variable-speed drive. The drive can be an AC (variable frequency) or DC drive, and can be connected via an I/O or control network (intelligent drive) or via hardwired analog and discrete I/O. This instruction is designed to work with all currently-available and many legacy Allen-Bradley drives, including Bulletin 1336, Bulletin 1395, PowerFlex 4 / 40 / 70 / 700 / 7000 and PowerFlex DC. This instruction will also work with drives and other variable-speed motor control products via discrete I/O for the start/stop/running signals and analog I/O for the speed reference and speed feedback signals.	• You need to operate a single-speed motor (running / stopped only). Use the P_Motor Instruction instead. • You need to operate a two-speed motor (fast / slow / stopped only). Use the P_Motor2Spd Instruction instead. • You need to operate a simple reversing motor (forward, reverse, stopped only). Use the P_MotorRev Instruction instead. • You need to operate a motor with multiple discrete speeds. You will need specific logic for this motor. The P_VSD Instruction is designed for motors with continuously variable (analog) speed, not multiple discrete speed selection.

Variable Speed Drive (P_VSD) Process Variable Faceplate

Operator Tab

Maintenance Tab

Variable Speed Drive (P_VSD) Engineering Tab Process Variable Faceplate



WWWAT CD Applications

The WWWAT CD contains sample applications that you can use to begin your Water and Wastewater project.

There are three major application groupings on the WWWAT CD - Water Treatment Development Tools, Wastewater Treatment Development Tools, and Pump Controller Station. Refer to Pump Controller Station on page 234.

Water/Wastewater Development Tools

Press the Water or Wastewater Development Tools to locate these applications.

LISTEN. THINK. SOLVE.
Introduction to Accelerator Toolkits
Install WWWAT on your computer
Terms and Conditions
WWWAT Version Changes and Updates
Water Treatment Development Tools
Wastewater Treatment Development Tools

Water/Wastewater Treatment Application Framework

All Water/Wastewater Treatment applications on the WWWAT CD share a common framework. This section examines that framework.

The WWWAT CD (Phase 4) contains the following Water/Wastewater Treatment applications:

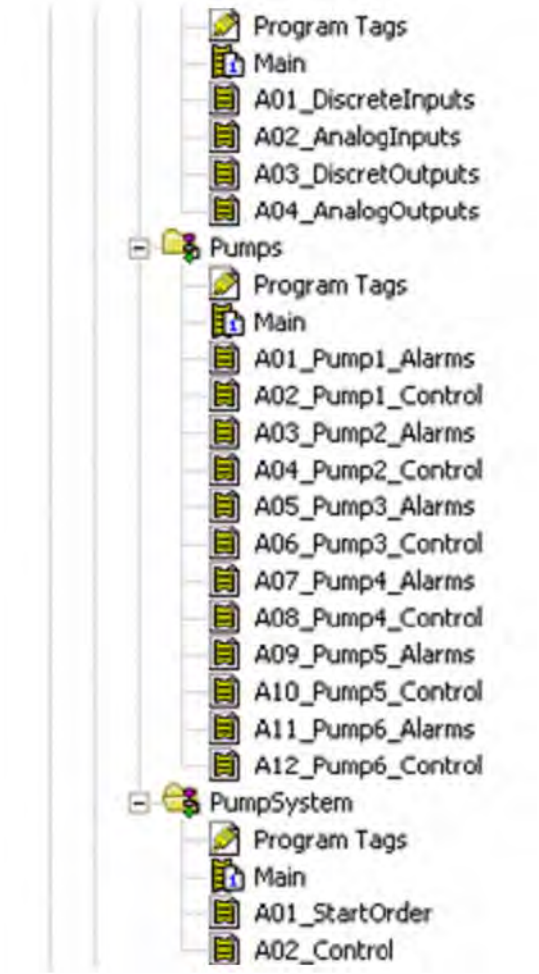
- Lift Station System
- Dosing Pump Station System
- Headworks System
- Secondary Treatment System
- Solids Handling System
- Chemical Feed System
- Flushing System
- Raw Water Intake Pump Station System
- Separation Station System
- High Service Pump Station System

The System Controller organization includes:

1. Task - Main Task, for example
2. Program - Pumps, for example
3. Routine - A01_DiscreteInputs for example

The components of this organization correspond to areas of the application. The task component is application-wide. The Program component should be used with the application's functional area and each routine is dedicated to a specific action within this functional area. For example, the entire Lift Station System is contained within a Task. Pump control is contained within a program and functionality within a pump, such as pump control versus pump alarming is separated into different routines.

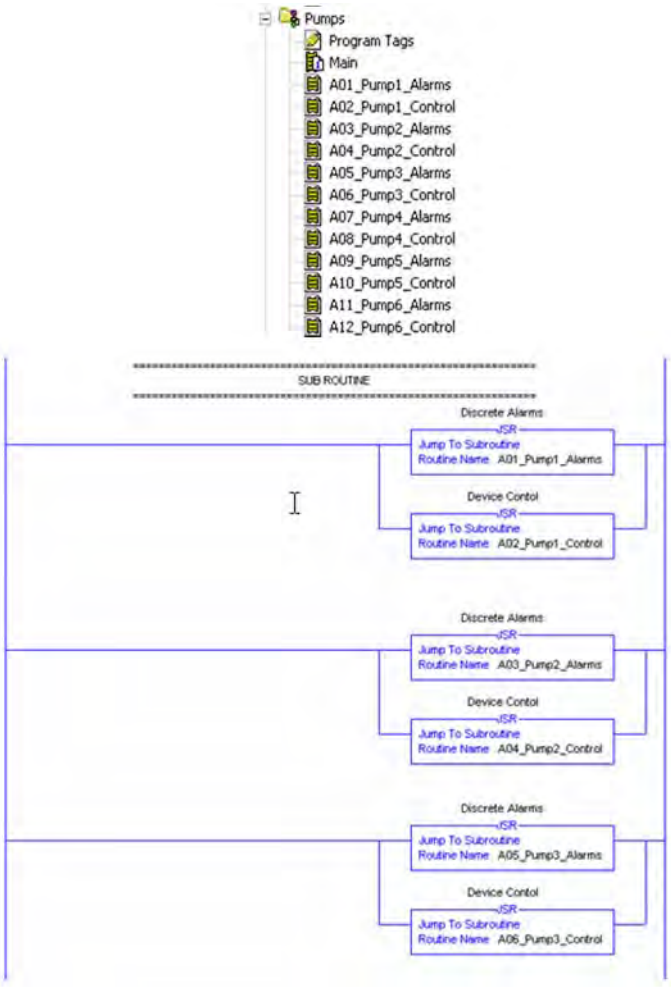
Lift Station System Application Organization



All programs contain a routine (Main) which is used to call all the other routines in the task. A Job Status Report (JSR) must be included in the Main routine for every routine in the program. For example, the following depicts a

Lift Station program for Pumps and its associated Main routine with a JSR to all other routines:

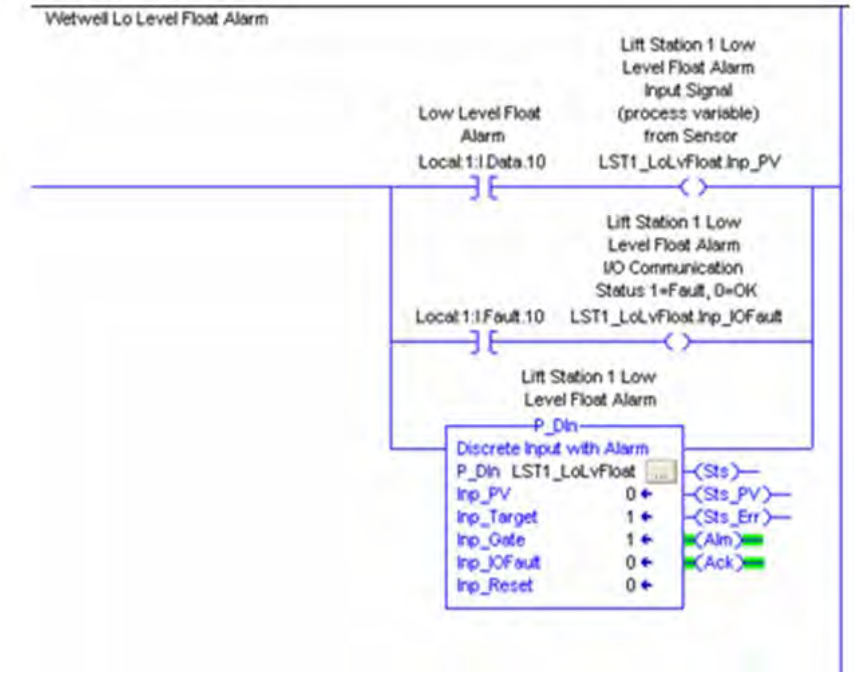
Program Example



Inputs and Outputs

The philosophy for real-world inputs and outputs are that they are "mapped" to tags in the Controller. Each I/O point occurs once in the Controller on the rung where it is mapped. For example, consider this rung:

Inputs and Outputs



In the Lift Station application, the Wet Well Low Level Sensor has been electrically connected to the 10th input on the card in slot one of the Local Rack.

The mapping of physical I/O to internal bits is good programming practice for the following reasons:

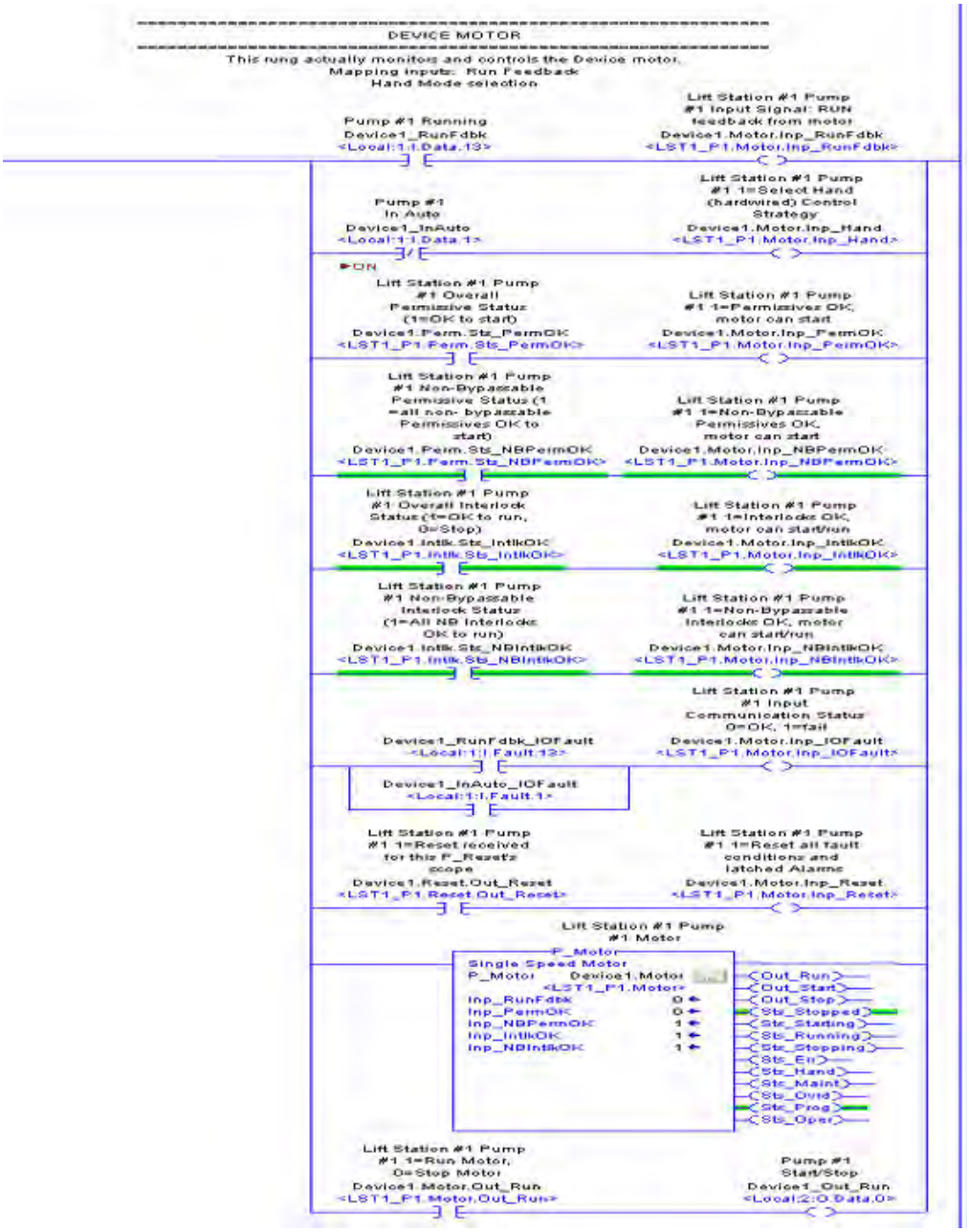
- If the electrical design changes, you only have to make one change in the program.
- Keeping all this inputs and outputs together keeps your application clean and consistent.

This mapping should be done on the same rung as the object that uses the input for the following reasons:

- When troubleshooting an object, you can immediately see the state of the I/O associated with it and check that the correct I/O is mapped to the correct location.
- It provides a simple understanding of which I/O applies to a particular object.

The following example depicts the P_Motor object. All I/O associated with this motor is mapped on the rung with the motor object.

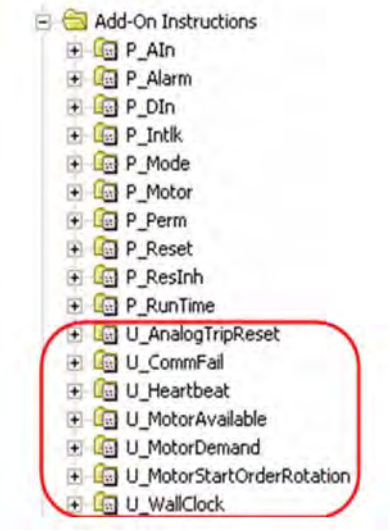
P_Motor Object



AOIs

Add-On Instructions populate their own folder in the Controller Organizer.

AOIs



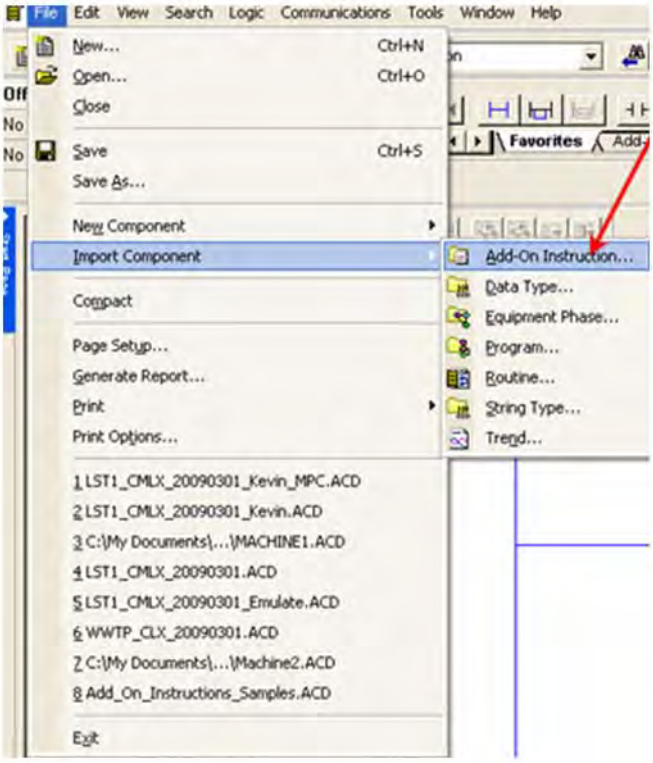
These applications contain two AOI classes, Process Library Modules (identified with the prefix P_) and User Modules. (prefix U_). The applications included in the WWWAT include AOIs from both the Process Library and those created specifically for these applications.

Using the Process Modules

The Process Modules are included in this Toolkit and can be imported into your application as required. These modules are distributed as XML (.L5X) and must be imported into your application as AOIs. To import an XML file into your application:

1. Click **File > Import Component > Add-On Instruction.**

Select/Import AOIs



Once you import an AOI, the system lists it in the Controller Organizer's AOI folder. The Process Library Module code may be viewed but not edited.

User Modules

The applications in this toolkit also contain user modules. These modules can be identified by the prefix U_ and have been written exclusively for the WWWAT and its associated applications. Use these AOIs as written or customize them as required.

Water and Wastewater Treatment Plant Applications

The Water and Wastewater Treatment Plant (WWTP) documentation package contains the following applications:

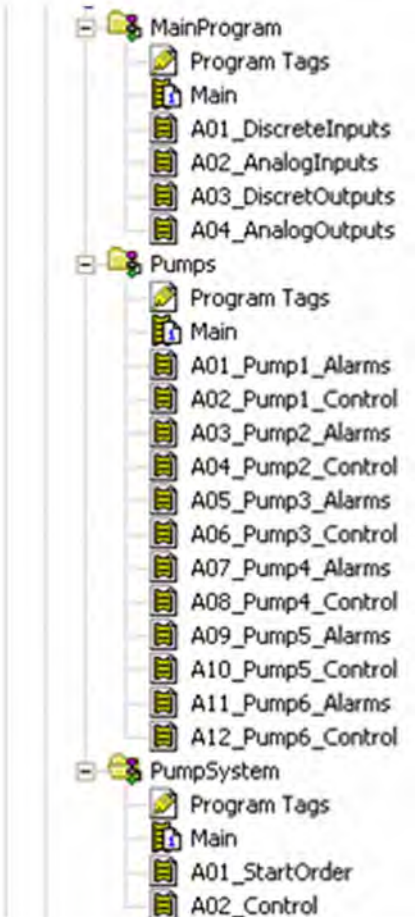
- Lift Station System
- Dosing Pump Station System
- Headworks System
- Secondary Treatment System
- Solids Handling System

Lift Station System Application

The WWWAT CD contains a Lift Station system application. This application is written assuming up to six pumps transfer the Lift Station building well contents to the Raw Sewage wet well at the Wastewater Treatment Plant. You can also modify the application use in a pumping application where pump control is based on the level of a wet well.

The Water and Wastewater sections of the WWWAT contain the Lift Station system application because of its general applicability. Its Controller organization is shown below:

Lift Station System Application Controller Organization



The functionality for each program and routine is:

- Main Program handles Lift Station-wide inputs and outputs.
  - Main routine calls the other routines in this program and includes a Wall Clock AOI that calculates the day of the week.It also includes a Pump Inputs simulation bit that you can use when testing the application.
  - A01_DiscreteInput maps inputs that are relevant throughout the Lift Station.
  - A02_AnalogInput maps analog inputs that are relevant throughout the Lift Station.
  - A03_AnalogInputs maps inputs that are relevant throughout the Lift Station.
  - A04_AnalogOutputs maps outputs that are relevant throughout the Lift Station.
- Pump System determines how many pumps to run and which pumps to start. This is a supervisor of the pumps.
  - Main routine calls the other routines in this program.
  - A01_StartOrder determines the order in which to start the pumps.

  - A02_Control calculates the pump demand (the number of pumps to start).
- Pumps handle only pump control. Start and Stop commands are issued to these programs and they handle unit level control of the pump motors.
  - Main routine calls the other routines in this program.
  - A0x_Pumpn_Alarms handles inputs and alarms relating to a specific pump.
  - A0x_Pumpn_Control handles pump control - permissives and interlocks for the motor as well as the control of the motor itself are handled here.

Control Description

Normally, the wet well pumps transfer the Lift Station well contents when the well level rises above the programmed high water level in the well. Alternatively, floats in the wet well control the pumps, in case of a Programmable Logic Controller (PLC) fault or level transmitter malfunction. This allows the pumps to turn on via a hard-wired circuit if the water level is too high.

Hand Mode

Place the pumps in Hand control:

1. Select Hand mode on the Drive Speed selector switch at the Feed Pump control panel.
2. Select Hand mode on the Pump Start selector switch at the Feed Pump control panel.
3. In Hand position, press the button station located on the control panel to start/stop a pump.

Remote Operator Mode

Place the pumps in **Remote Operator** control:

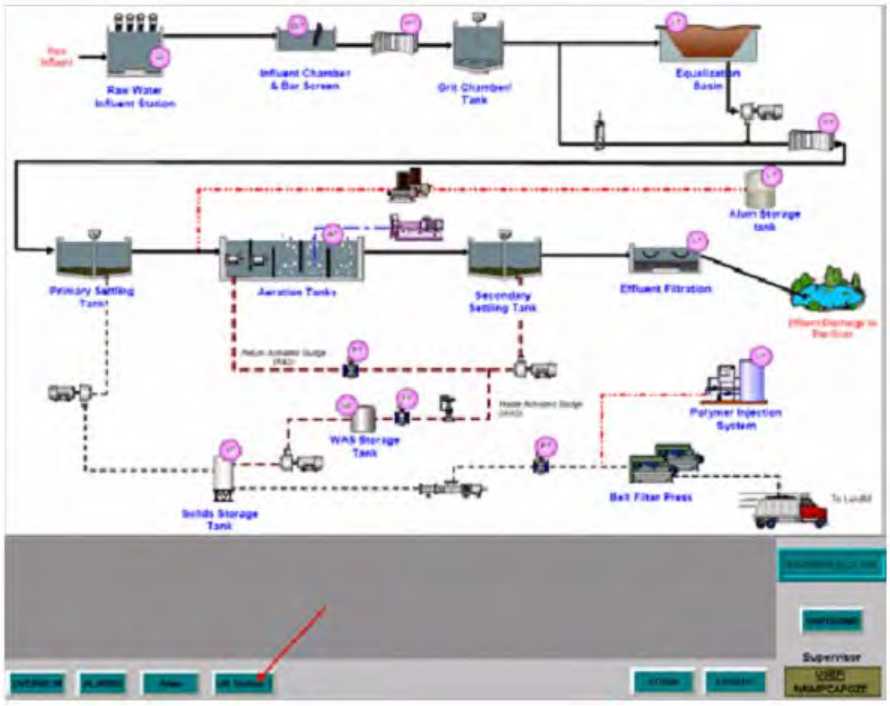
1. Select **Remote** on the MCC for pumps 1 and 2. Verify that circuit breakers and disconnects are turned on.
2. Select **Operator** mode on the **Lift Station Pump No.x Faceplate** screen for each of the pumps 1 and 2.
3. Verify that the pump status is in service on the **Lift Station Pump No.x Faceplate** screen with no faults.

Human Machine Interface (HMI) Control

Go to the **Lift Station** screen from the **HMI** screen:

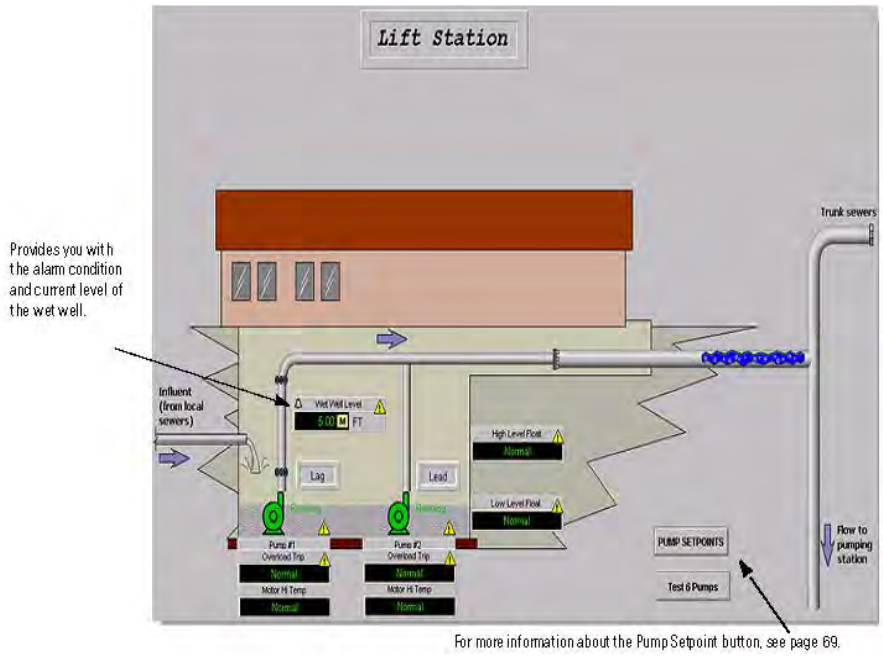
1. Click the **Lift Station 1** button. The system displays the **Lift Station** screen.

Selecting the Lift Station 1 Button on the HMI Screen



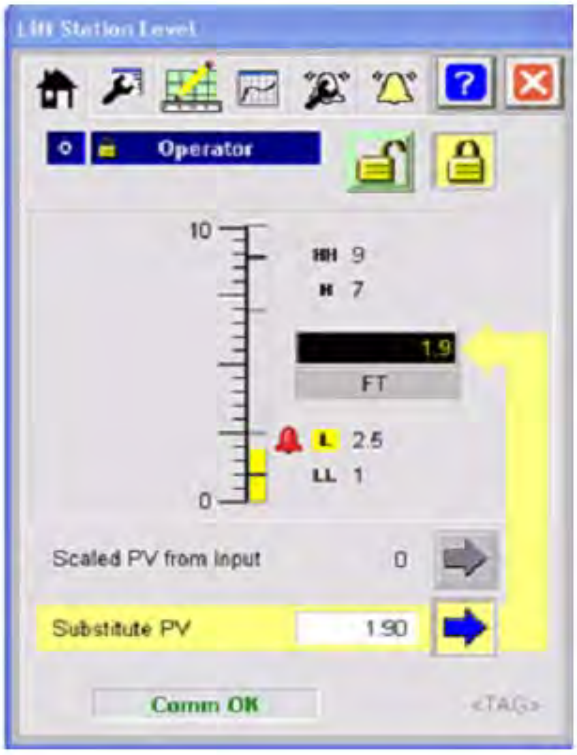
2. Click the **Wet Well Level Faceplate**. The system displays the Process Library Faceplate for the analog module that is monitoring the Wet Well Level.

Lift Station Screen



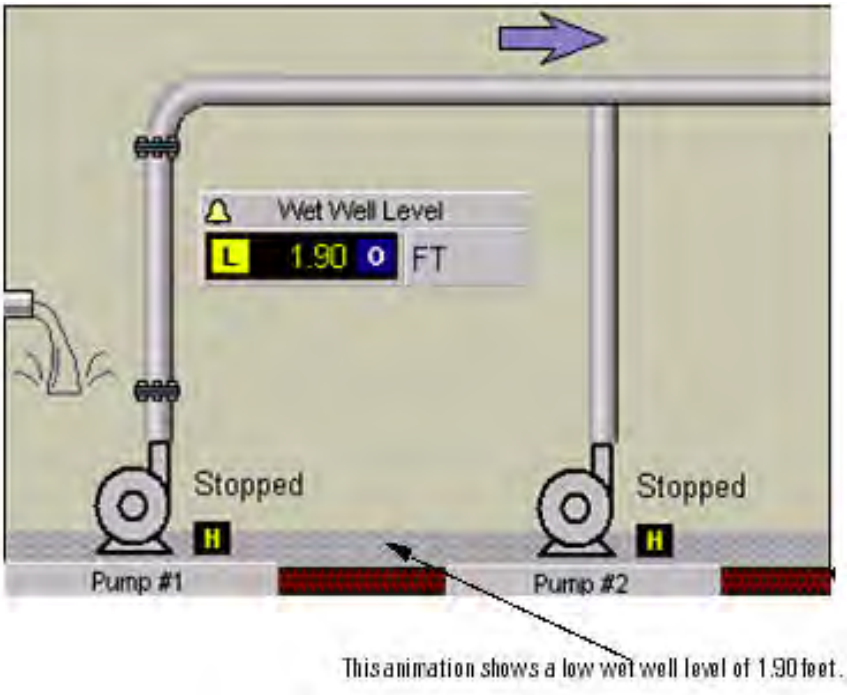
Lift Station Level Faceplate

This analog faceplate provides detailed information about the wet well level.

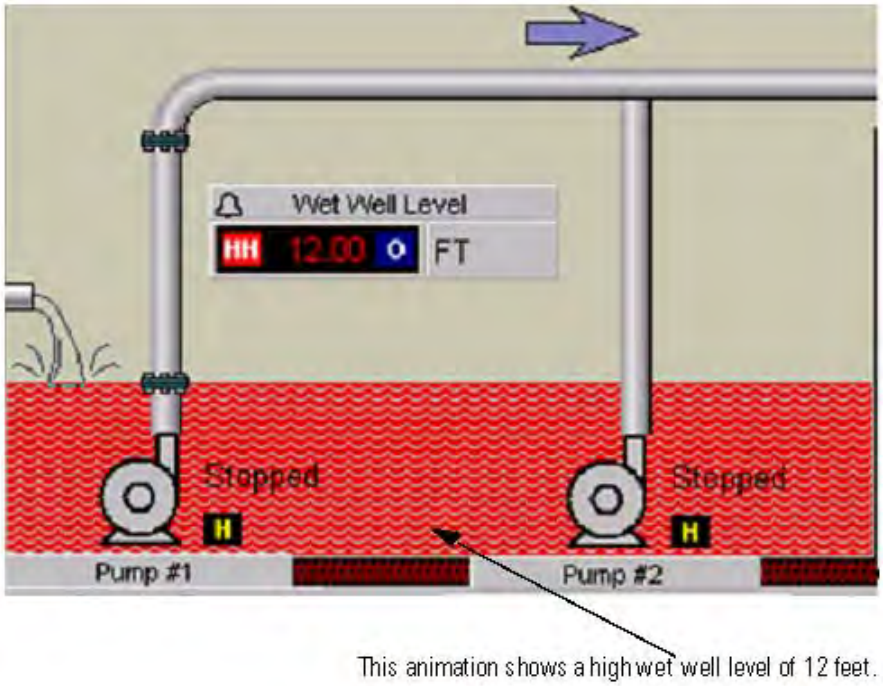


The **Lift Station** screen depicts the Wet Well Level with a water animation.

Lift Station Wet Well Level Animation



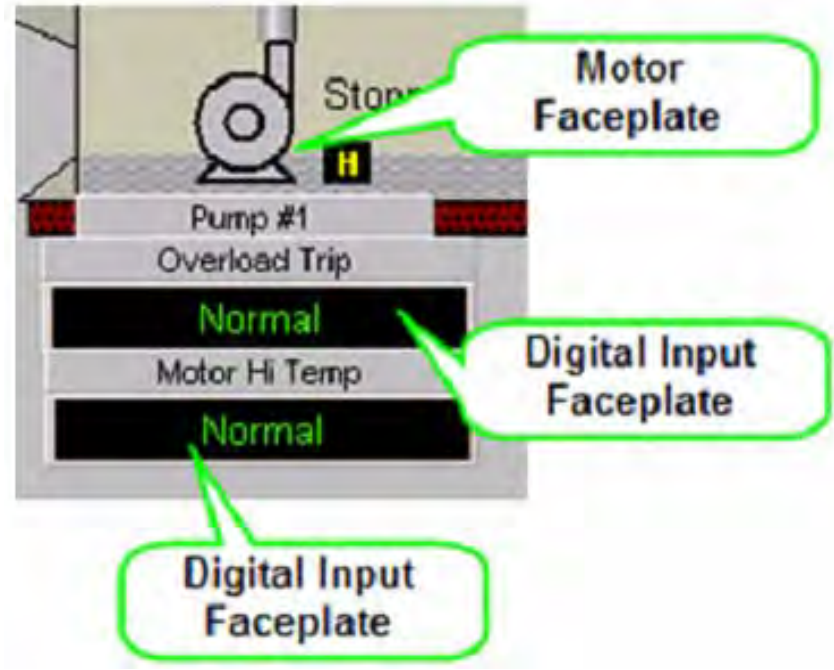
Lift Station Wet Well Level Animation



Pump Faceplates

For each pump in the Lift Station, there are a Pump, Motor, and Digital Input Faceplate.

Lift Station Pump Faceplate



Lift Station Motor Faceplate

Lift Station Digital Input Faceplate

Pump Setpoints

The **Pump Setpoint** screen provides you with information about when each pump should start and stop.

1. Click the **Pump Setpoints** button that appears on the **Lift Station** screen. The system displays the **Pump Setpoint** screen.

Lift Station Pump Setpoint Screen

2. Use the **Start** or **Stop** fields to adjust the setpoint for when each pump starts and stops. The setpoints are based on the **Wet Well Level**.

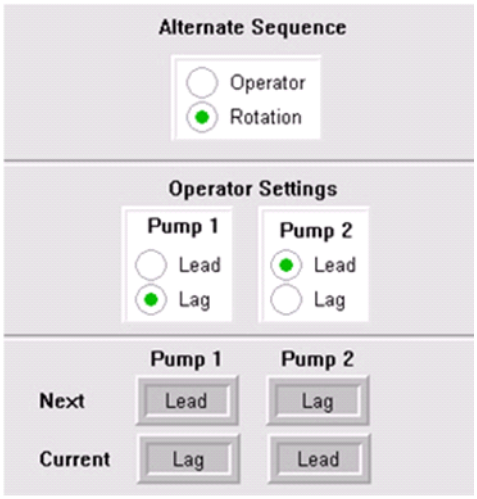
   For example, in the illustration above, the lead pump starts pumping when the well level goes above 1.0 feet. The pump stops when the level drops below 0.5 feet. This results in a dead band of 0.5 feet. The lag pump operates similarly, except that it starts at 2.0 feet and stops at 1.5 feet. You can easily adjust all of these values on this single screen.

3. Adjust the Lead and Lag pumps using the **Operator Settings** switches in the lower right side of this screen.

a. Click the appropriate radio button to assign a pump as Lead or Lag. The screen contains **Lead** and **Lag** radio buttons for Pump 1 and Pump 2.

   For example, in the illustration below, pump 1 is assigned as the lag pump and pump 2 is assigned as the lead pump. Pump 2 will start when the water level reaches the start level for the lead pump and stop when the water level drops to the stop level. You can change these assignments at any time.

Lift Station Pump Setpoint Screen



The sequence of pumps is shown below these switches. The sequence displayed will reflect the sequence currently active in the Controller. If any pump fails to start, the next pump in the sequence will start.

For example, if the lead pump's disconnect is pulled and does not start, the next pump in the sequence will run. The above illustration is showing only two pumps. The sample code in the Controller provides routines for up to six pumps.

There is a development screen provided that can be used as a starter for additional pumps. It can be opened on the HMI by selecting the Test 6 Pumps button from the overview screen.

Wet Well pumps are not interlocked with the main plant well. If the main well is in an alarm state, the Lift Station pumps will start in Auto.

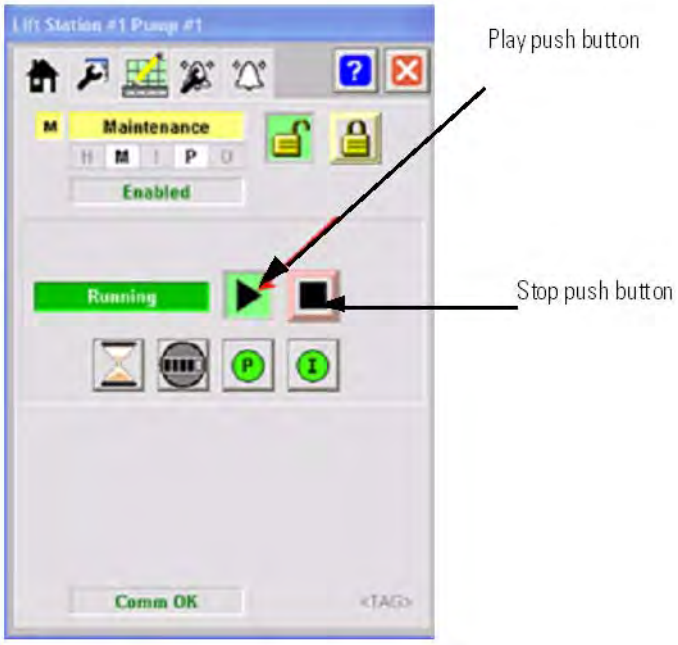
Run Pumps Manually

Use the following steps to run the pumps manually from the **HMI**:

1. While in **Maintenance** or **Operator** mode, navigate to the **Lift Station** screen.
2. Click on the desired pump and then click on the **Play** button.

3. Click on the **Stop** button to stop the pump from the **Control** screen. In manual mode, the pump will continue to run regardless of a low **Wet Well** level.

Run Pumps Manually



Place Pumps in Remote Program

Place the pumps in **Remote Program** control.

1. Select **Remote** on the MCC for pumps 1 and 2.
2. Verify that the circuit breakers and disconnects are turned on.
3. Make sure on the **Lift Station Pump N.ox Faceplate**, for pump numbers 1 and 2 are in the unlocked **Operator** mode.
4. Verify that the pump status is in service on the **Lift Station Pump N.ox Faceplate** screen with no faults.
5. Verify that the correct pump rotation sequence has been selected and the **start/stop** pump set points are set to the correct level.

Alarms

The Lift Station generates these two types of alarms.

- Process Alarms
- Equipment Alarms

Process Alarms

These are the six different types of Process Alarms:

- Low Level (the wet well is low)
- High Level (the wet well is high)
- Low Low Level (the wet well is extremely low)
- High High Level (the wet well is extremely high/or is overflowing)
- High Level Float
- Low Level Float

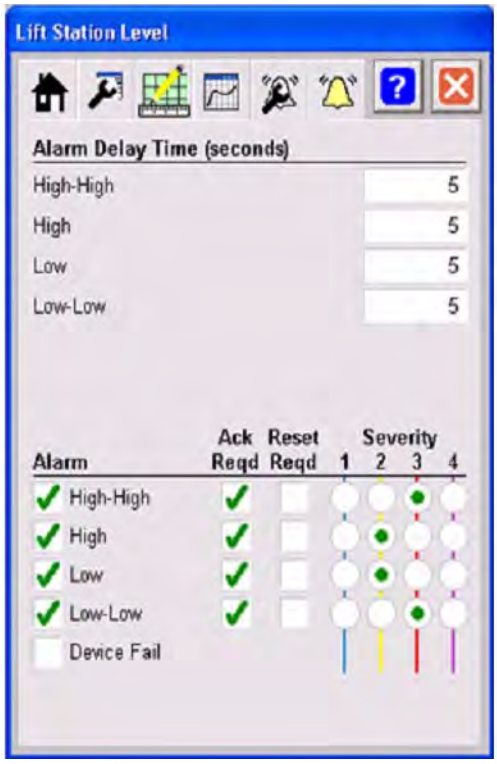
Equipment Alarms

These are the four different types of Equipment Alarms.

- **Pump Permissive** - Inhibit Restart
- **Pump Interlock** - Motor Overload, Motor High Temperature, or Low Water Cutoff
- **Start-Stop Pump Failure** - Check the MCC selector switch and local disconnect
- I/O Fault

Use the **Lift Station Level Faceplate** to configure the analog Process Alarms changing condition. Users with the correct security level can also inhibit both alarms.

Lift Station Level Faceplate



Customization

The example programs included on the WWWAT CD provide you with a start to the application development. Typically, many customizations and adjustments have to be made to the application to make it operational for a particular project.

Customization is a vital part of the software development. This section outlines some of the basic tasks that must be done for this customization and other steps may be necessary. The important point to remember is that these example applications only serve as a start. It is the responsibility of the application engineer to assess the requirements of the project, take ownership of the application, and drive it to completion.

Some general customization concepts will be discussed in this section. Though you may not be interested in the Lift Station application, it is an important section to read because the customization information contained in this section applies to other areas as well.

I/O Assignment

As mentioned earlier in this document, I/O is mapped at one place in the application for each I/O point. As part of customizing the example Lift

Station application, be sure to check all the locations for I/O that is mapped including the following:

- MainProgram - A01_DiscreteInput - rungs 0 - 4
- MainProgram - A02_AnalogInput - rungs 0 - 3
- MainProgram - A03_DiscreteOutputs - as needed
- MainProgram - A04_AnalogOutputs - as needed - this routine is not used in the example

For Pump I/O, each pump has its own routines in the Pumps program. The routines are numbered sequentially, A01, A02, etc. For I/O mapping go to the following rungs:

- Pumps - A0x_Pumpn_Alarms - rungs 0 - 4
- Pumps - A0x_Pumpn_Control - rungs 3 - 5

Where: x = sequential routine number, n = pump number

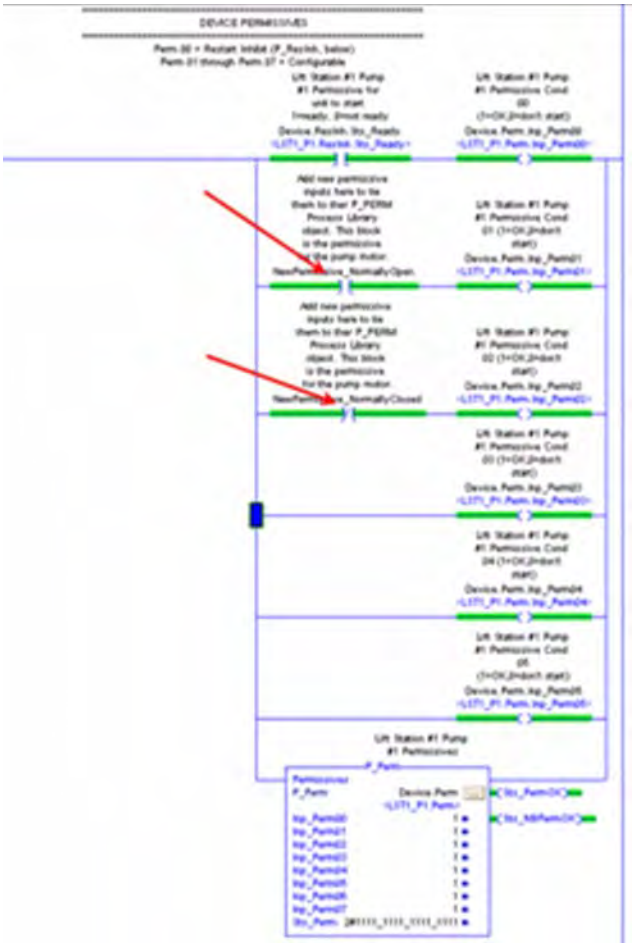
This is not intended to be a complete list of the I/O assignments necessary. It is only intended to point out some required rungs that must be customized for a particular application. As an important step in the software development process, care should be taken to properly assign I/O to all the necessary places in the software. Many I/O points for a specific application may not be anticipated by this example application. In these situations, additional software must be developed to account for these points.

Motor Permissives and Interlocks

The sample Lift Station application provides places for additional permissives and interlocks to be added to the program. Keep the following points in mind:

- Permissives allow or prevent a motor from starting. If a permissive is not true, the motor will not start when it receives a start command. But once the motor is started, it will continue to run on a loss of a permissive.
- Interlocks allow or prevent a motor from continuously running. If an interlock is not true, the motor will not run when it receives a start command. Once the motor is started, it will stop on a loss of an interlock.
- To include additional permissives for a pump motor to start, add contacts to rung 3 of A02_Control in Pump 1 or Pump 2.
- Each permissive input is mapped on a branch in this rung. All these permissives are inputs to the Process Library AOI that is located on the last branch of the rung. All permissives must be true to allow the pump to start. If there is an input that is normally closed, use an XIO instruction on the branch of the rung to properly map it into this AOI.

Motor Permissives and Interlocks



Resets

Fault and Alarm resets in the application are accomplished through a P_Reset block from the Process Library. This reset object distributes the Reset command to all the Process Library AOIs that may require a reset.

Care must be taken in deciding how to distribute the reset commands. This must be planned before the customizations that follow can be completed. Considerations include questions such as:

- What devices will reset when a particular button is pressed?
- How are devices to be grouped they are reset at the same time with the same reset button?
- Do some devices overlap into more than one Reset group?

For example, in the Lift Station application provided in the WWWAT, the reset is distributed to all the pumps. Rung 2 of each Pump Control routine has a

branch for the **Reset** button. To remove a pump from this Reset group, tie a different **Reset** button to this branch.

In general, there are three important customizations that are required with this object:

- Assigning all the Reset Required bits to the P_Reset object
- Assigning all the devices, such as buttons that can initiate a reset to the P_Reset object
- Properly distributing the Reset command to all objects that will use its reset.

Lift Station Pump Control Rung 2

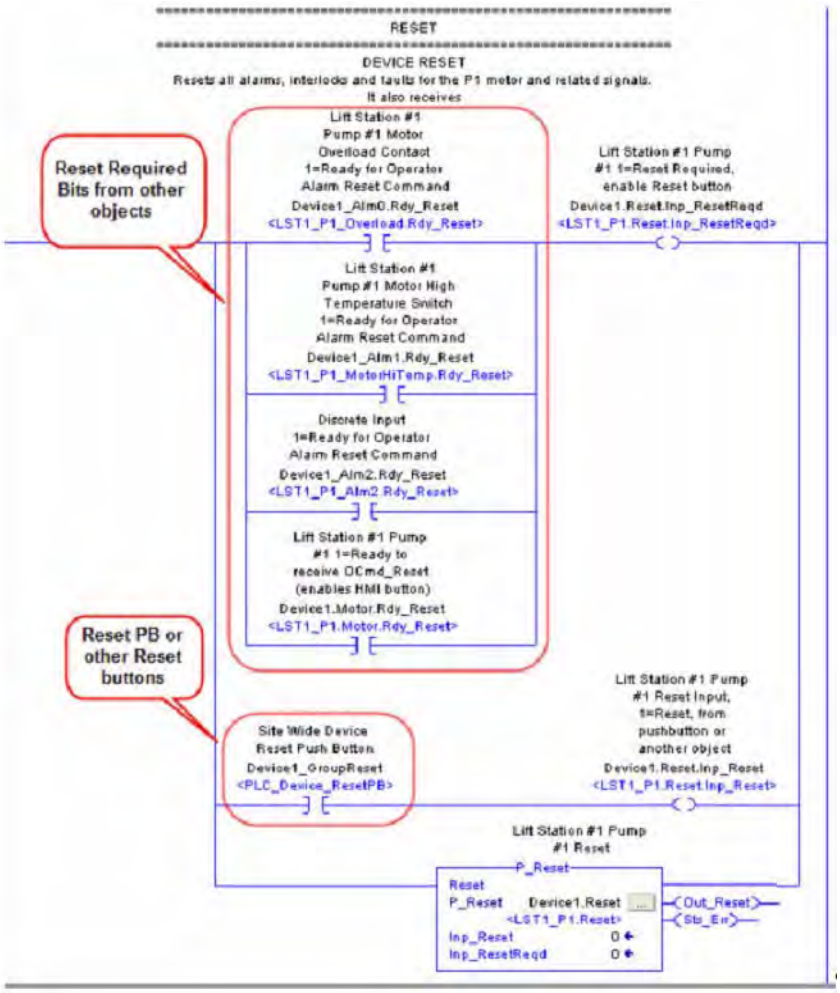
Assigning the Device That Initiates the Reset

Assigning the device that initiates the reset is also done on the rung with the P_Reset object. Add branches here for all devices that can initiate a Reset command to this P_Reset object. These devices may include commands from the HMI, hard-wired reset buttons or other operator interfaces that provide a Reset command.

Assigning the Reset Required

Assigning the Reset Required bits is done on the rung with the P_Reset object. All Reset Required bits from all objects that will receive the reset command must provide a Reset Required bit to this reset. Add branches to this rung for each device that will fall within the group for this P_Reset. The illustration below demonstrates these reset required bits and the branch required.

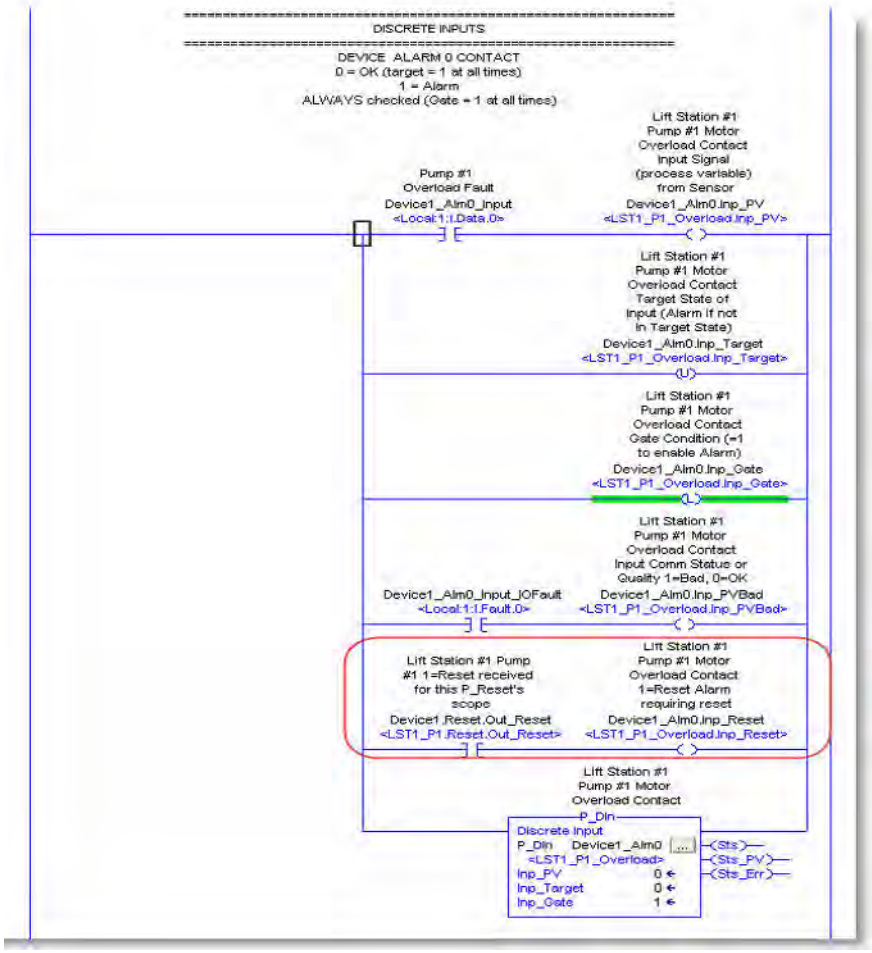
Lift Station Reset Command



Distributing the Reset Command

Once a reset is initiated and the P_Reset sends its Reset command, all devices that are to receive this reset must be mapped to the proper Reset bit. This is done in a distributed manner. Each device that is to receive the reset will have a branch on the rung mapping this Reset command to its Reset input. See the **Lift Station Reset Command with a Digital Input Object** illustration for an example with a Digital Input object. The idea is the same for all other objects that accept a reset. Each rung for an object that requires a reset will require a branch like the one shown below.

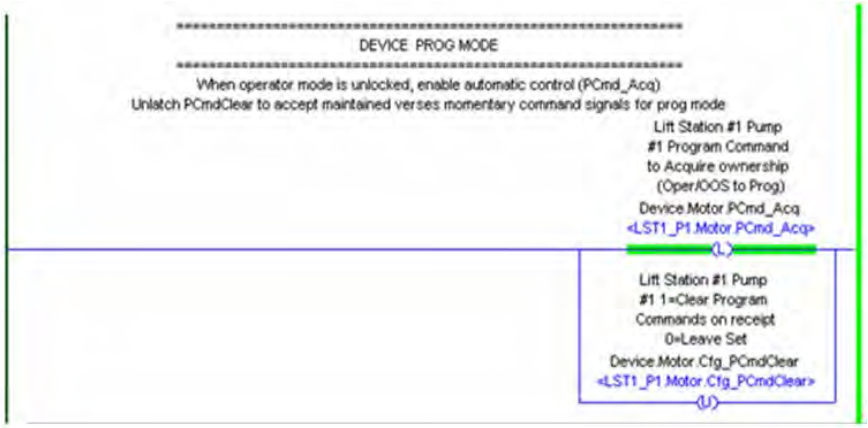
Lift Station Reset Command with a Digital Input Object



Mode Selection

Routines for Pump 1 and Pump 2 include a rung that handles mode operation of the routine. This rung is shown in the **Lift Station Pump 1/Pump 2 Mode Selection Rung** illustration.

Lift Station Pump 1/Pump 2 Mode Selection Rung



By latching on the Program Acquire Command, the application will default to Program Control of the application in the absence of a request to switch to **Maintenance** or **Hand** modes. When one of these modes is requested, the program will switch to these modes. However, when the request is no longer active, the application reverts to Program Control.

Unlatching the Program Command Clear bit determines the style of mode control. With this bit set to zero, a level type of control is required for mode selection. This means that to remain in a particular mode, the request for that mode must be maintained. For example, to select Program mode, the Program request command bit must remain 1. Latching this Program Command Clear bit would select an Edge type of control where setting the Program bit once on a one-shot will trigger the transition to Program mode. Once the transition occurs, the command bit is turned off. The command to change the mode is called a command acquisition bit. Within the application, modes change by manipulating these PCmd_Acq or OCmd_Acq bits. PCmd is the request for program control or automatic, OCmd is operator control.

In general, the change of mode with the Program Command Clear bit latched is sensitive to the change of state of the mode acquire bit whereas with the Program Command Clear bit unlatched, the state is determined by the state of the mode acquire bit itself.

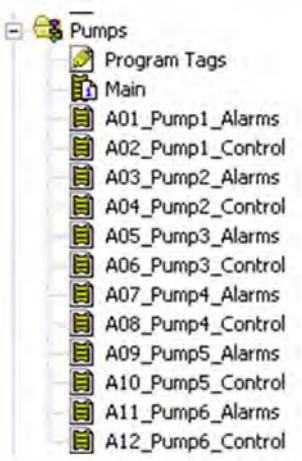
This application is using the program command clear bit unlatched as the style of mode selection - this is the maintained style of mode control. If you wish to change this type of control to the Edge style, an understanding of the method of mode selection within the Process Library is required. These paragraphs have touched on this topic, but more information can be found within the Process Library documentation. Refer to the manual for the Mode object for more detailed information.

Adding or Removing Pumps

The Controller application provides routines for up to six pumps. The HMI application is written for two pumps although a test screen is provided to serve as a start or seed for adding additional pumps to the HMI. Both applications can be adjusted to suit your process but this requires an understanding of the software and careful customization. This section describes some of the details that must be tended to as pumps are added or removed.

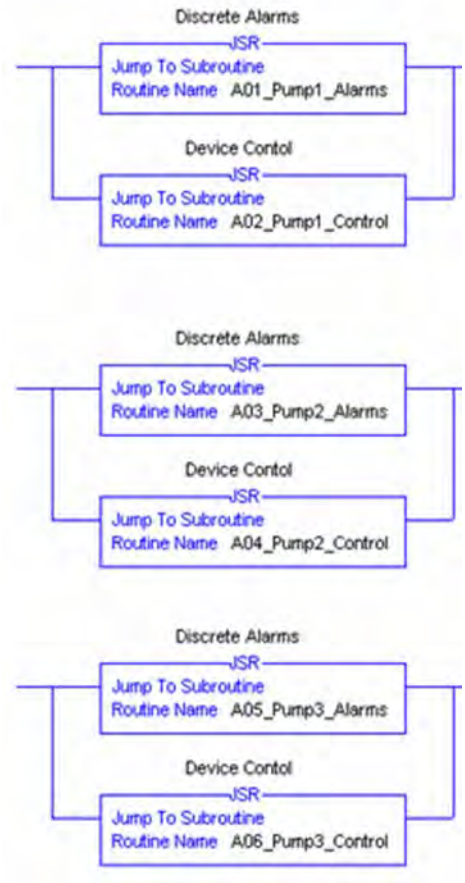
To adjust the number of pumps in the Controller, first add or delete routines as necessary to have one alarm and one control routine for each pump. Note that these routines are numbered sequentially with A0x where x is the sequential. You may number the pumps or name them as required for your application. You may choose to name a pump PumpWest instead of Pump1 for example.

Lift Station Pump Controller Routines



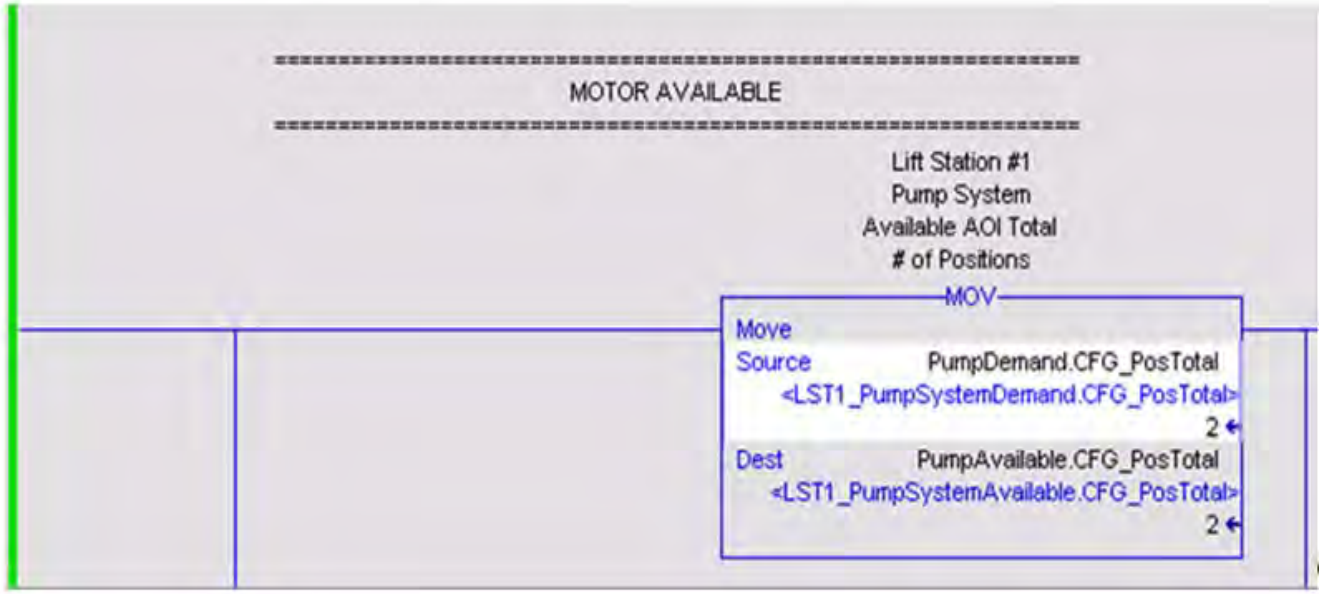
All these routines should be contained in the Pumps program and every routine must have a JSR instruction in the Main routine.

Lift Station Pump JSR Instructions



In A02_Control of the Pump System Program, configure the number of pumps total by setting Pump.Demand.CFG_PosTotal to equal the number of installed pumps.

Lift Station Pump 1/Pump 2 Mod

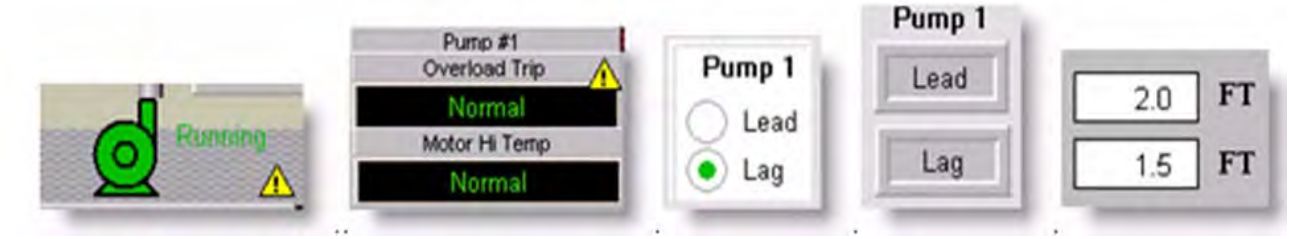


After making these changes, map all the I/O associated with the additional pumps. Refer to the I/O Assignment section of this document.

Changes to the HMI application can be summarized by explaining that adding pumps to the HMI simply requires duplicating existing animation on the screen and assigning the proper pump tags to each of the HMI components. Be sure to not only add additional animations for the pumps, but also for the discrete inputs located under each pump and for pump sequence control indicating lead and lag.

Below are examples of all the components that should be duplicated for this application. Note that the descriptions change for each. For example, Pump 1 to Pump 3 and the backing tags must be updated to the appropriate tag in the Controller. Some of these animations are on the main **Lift Station** overview screen and some are on the **Pump Setpoints** screen.

Lift Station Duplicated Component Examples



A basic test screen for 6 pumps is provided to give you a start on creating additional pumps. This can be accessed via the **Test 6 Pumps** button on the **Lift Station** screen.

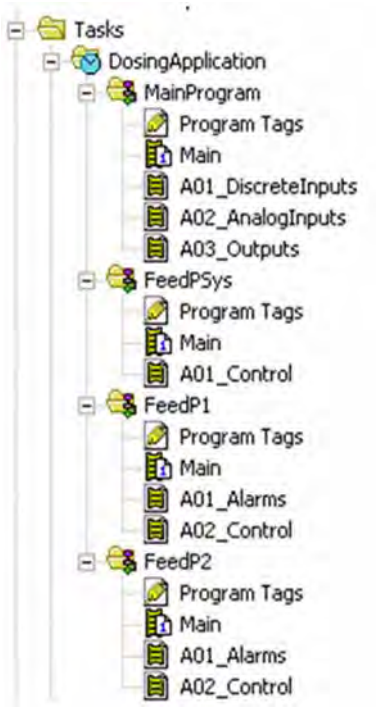
This **Test 6 Pumps** button is not intended to remain in a working application and should be removed once it is determined how many pumps the application will have. The **Lift Station Test 6 Pumps Example** illustration depicts a test screen with six pumps. This serves only as a start from which to customize your application.

Lift Station Test 6 Pumps Example

Dosing Pumps Application

The Dosing Pumps application is provided on the WWWAT CD. This is the Dosing Pump application's organization within the Controller.

Dosing Pumps System Application Controller Organization



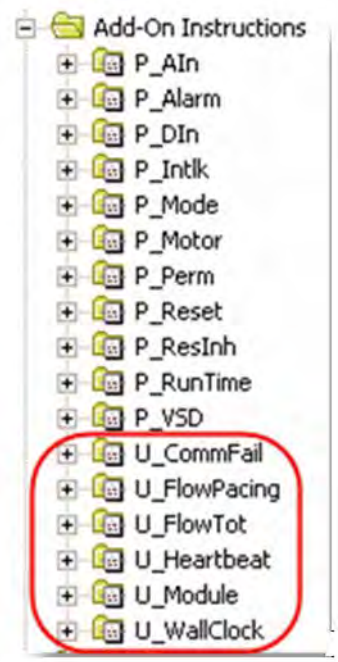
This task resides in a Controller located in the main facility of the plant using the Dosing Pump application. It is not intended to be the only application in the Controller. A ControlLogix processor is specified for this application for that specific reason. It is assumed the processor will be running other systems of the plant.

The organization of this application is similar to that of the Lift Station. Specifically, the functionality for each program and routine is:

- Main Program handles general Dosing Pump application's functionality, including:
  - Main routine calls the other routines in this program and includes a Wall Clock AOI that calculates the day of the week. It also includes a Pump Inputs simulation bit that you can use when testing the application.
  - A01_DiscreteInput maps inputs that are relevant throughout the Dosing Pumps.
  - A02_AnalogInput maps analog inputs that are relevant throughout the Dosing Pumps.
  - A03_AnalogInputs maps inputs that are relevant throughout the Dosing Pumps.
- PSys determines how many pumps to run and which pumps to start. This is a supervisor of the pumps.
  - Main routine calls the other routines in this program.
  - A01_Control contains the code for the pump decisions and metering.
- Feed Pump 1 and Pump 2 handle only pump control. Start and Stop commands are issued to these programs and they handle unit level control of the pump motors.
  - Main routine calls the other routines in this program
  - A01_Alarms handles inputs and alarms relating to a specific pump
  - A02_Control handles pump control - permissives and interlocks for the motor as well as the motor control itself are handled here.

Add-On Instructions are used extensively in this application. There is a collection of Process Library AOIs and a collection of other AOIs developed specifically for this application. Process Library AOIs can be identified by a prefix "P_" in their name. The other AOIs have a prefix of "U_" as shown in the AOI illustration.

AOIs



Control Description

Phosphorus concentrations in the final effluent are limited by the National Pollutant Discharge Elimination System (NPDES) Permit, meaning that the plant is required to implement treatment steps. Feeding Alum to the wastewater increases the amount of sludge generated which will result in larger quantities sludge in the secondary clarifiers.

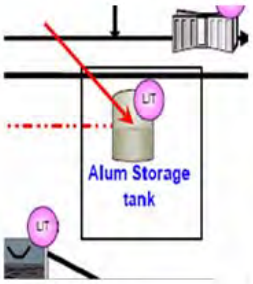
The Alum is pumped from the two storage tanks by two metering pumps (numbers 1, and 2). These pumps are paced by the plant flow rate.

WARNING

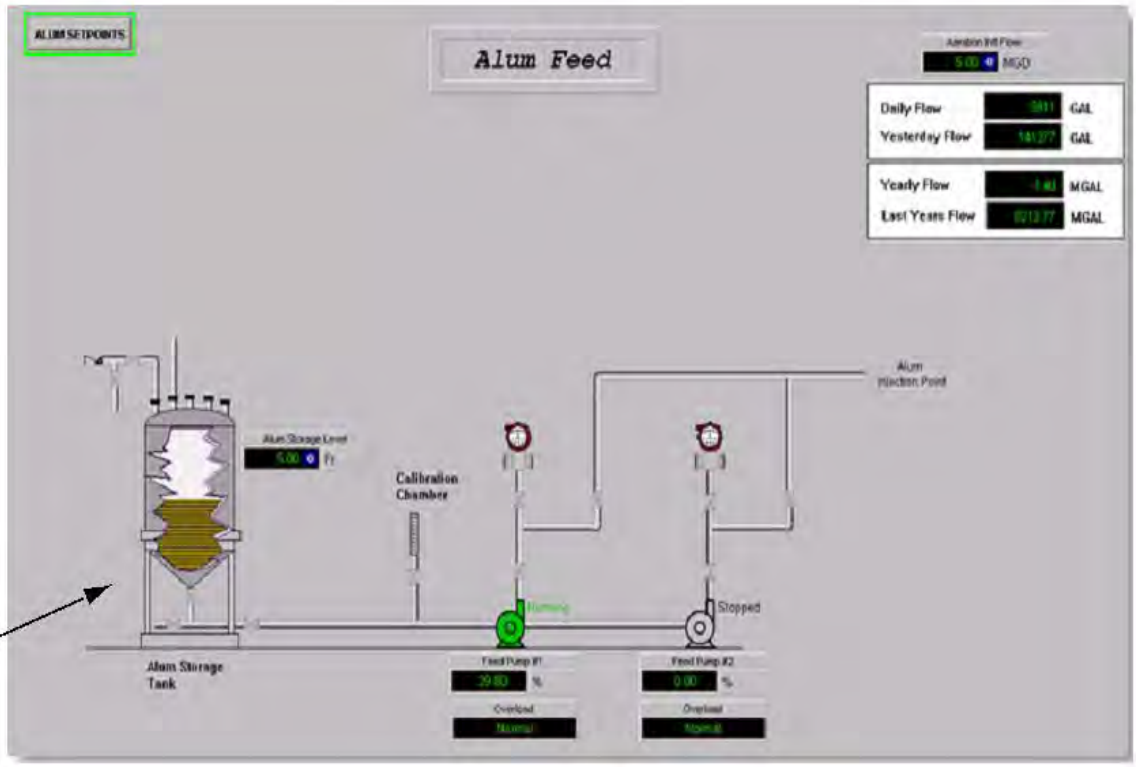
Alum is a potentially dangerous substance and must be handled with care.

From the overview screen, click the **Alum** button or the Alum Storage Tank icon to display the **Dosing Pump Application** screen.

Selecting the Alum Button



Dosing Pump Alum Feed Screen



The lower left of the **Alum Feed** screen shows the status of the Alum storage. The Alum storage tanks are equipped with ultrasonic level sensors to measure the gallons stored Alum in each tank. The tank volume and pump status are displayed on the **Alum Feed Overview** screen. Selecting the Alum Storage

Level display opens the **Analog Input Faceplate** for the Alum level. This is a standard Process Library Faceplate.

To obtain pump status and control, click either pump icon. Clicking a pump opens the Process Library Faceplate for VFDs. The variable speed Alum Feed Pumps may be operated in either Hand or Remote mode as selected by a Remote-Off-Hand selector switch at the associated control panel.

Hand Mode

Use the following steps to place the Feed Pumps in Hand Control mode.

1. Select Hand mode on the Drive Speed selector switch at the Feed Pump control panel.
2. Select Hand mode on the Pump Start selector switch at the Feed Pump control panel. In Hand position, the operator starts and stops the pump using the appropriate button station located on the control panel. To adjust chemical dosing use the Motor Speed potentiometer at the Feed Pump Control Panel.

Remote Operator Mode

Use the following steps to place the Feed Pumps in **Remote Operator** control mode:

1. Select Remote mode on the Drive Speed selector switch at the Feed Pump control panel.
2. Select Remote mode on the Pump Start selector switch at the Feed Pump control panel.
3. Select **Operator** mode from the **HMI**.
4. The pump is started and stopped remotely from the **HMI** screen. A faceplate is displayed by clicking on the **Feed Pump** icon.
5. To start the pump, press **Play** and to stop the pump, press **Stop**.
6. To modulate the Feed Pump rate, either click in the **Operator Setpoint** box and type in a value between 0 and 100 percent to change the speed value in the **Speed Setpoint** box.
7. To remove the Feed Pump from service, click **Disable**, and to place the unit back in service, click **Enable**.

Remote Program Mode

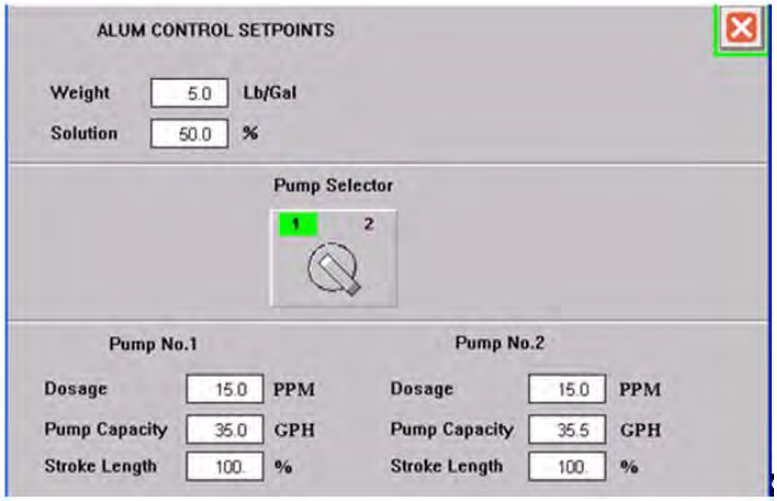
Use the following steps to place the Feed Pumps in Remote Program Control mode.

1. Select Remote mode on the Drive Speed selector switch at the Feed Pump control panel.

2. Select Remote mode on the Pump Start selector switch at the Feed Pump Control Panel.
3. Select the Program mode from the HMI.

The pump runs and the output (feed rate) is controlled by the flow pacing signal and the dosage (adjustable at the HMI from 0- X ppm), entered by the operator. Transfer between the Controller operator and Program modes is smooth. The pump output in gallons per hour (feed rate) and stroke speed setpoint is calculated. The Program Logic Controller (PLC) will output the speed signal to the pump based on the appropriate flow pacing signal.

Alum Control Setpoints



Alarms

The Supervisory Control and Data Acquisition (SCADA) system generates these two types of alarms.

- Process
- Equipment

Process Alarms

There are the four types of Process Alarms.

- Low Level (the Alum storage tank is low)
- High Level (the Alum storage tank is high)
- Low Low Level (the Alum storage tank is extremely low)
- High High Level (the Alum storage tank is extremely High)

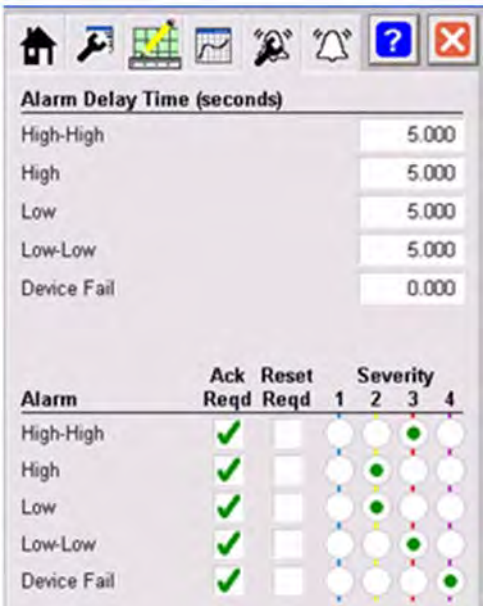
Using the Analog Signal faceplate, all four process alarms can be configured for changing condition. Users with the correct security level can also inhibit all alarms.

Equipment Alarms

These are the two types of Equipment Alarms.

- **Alum Faul**t - Check the Feed Pump control panel for system or over current faults.
- **Start-Stop Pump Failure** - Check the local disconnect and pump status.

Process Alarms



Customization of the Dosing Pumps Application

General customization notes are included in the Lift Station Application section (page 102) of this chapter. Refer to this section before customizing any application, including the Dosing Pumps. This section describes customization specific to the Dosing Pumps application.

I/O Assignment

As in the Lift Station, I/O is mapped into this application. This is done in the following project locations:

- MainProgram - A01_DiscreteInput - rungs 0 - 4
- MainProgram - A02_AnalogInput - rung 0
- MainProgram - A03_Outputs - as needed - this routine is not used in the example
- FeedPump1 - A01_Alarms - rungs 0 - 4
- FeedPump1 - A02_Control - rungs 3 - 5
- FeedPump2 - A01_Alarms - rungs 0 - 4
- FeedPump2 - A02_Control - rung 5 for the motor related I/O

Additional Pumps

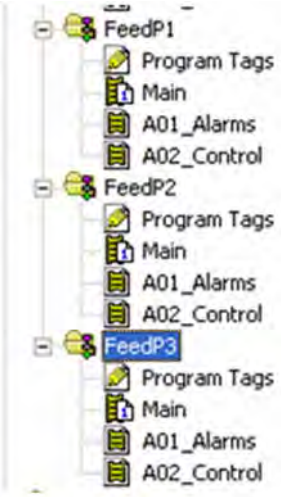
To add additional pumps to the Dosing Pump application:

1. Adjust A01_Control in FeedPSys to include for the additional pumps. Modifying A01_Control in FeedPSys requires customization that is specific to the application. You must use your judgment to determine how to incorporate these changes.
2. Add additional pump programs as required. These will be duplicates of FeedP1 and FeedP2.

To add additional Feed Pumps:

1. Copy and paste the existing FeedP1 or P2 program. Both programs are identical, so either one can be copied.

Feed Pump Program Folders



2. Create new controller-scoped tags for the third pump.

Controller Scoped Tags

Name	Data Type
WWTP_FeedP1	U_MotorVSD
WWTP_FeedP1_FlowPacing	U_FlowPacing
WWTP_FeedP1_OverLoad	P_DIn
WWTP_FeedP2	U_MotorVSD
WWTP_FeedP2_FlowPacing	U_FlowPacing
WWTP_FeedP2_OverLoad	P_DIn
WWTP_FeedP3	U_MotorVSD
WWTP_FeedP3_FlowPacing	U_FlowPacing
WWTP_FeedP3_OverLoad	P_DIn

3. Locate the program scoped tags for the new Pump 3 program.
4. Define the Alias for Device (and the other associated tags) as this new Controller-scoped tag.

Alias Device Definition Screen

Name	Alias For
Device	WWTP_FeedP3(C)
Device_Alm0	WWTP_FeedP3_OverLoad(C)
Device_Alm0_Input	I_FeedP2_OverLoad(C)
Device_Alm0_Input_IOFault	I_FeedP2_OverLoad_IOFault(C)

5. Configure and alias for all I/O for the new pump. The **Required Pump I/O** illustration depicts the subset of the I/O required.

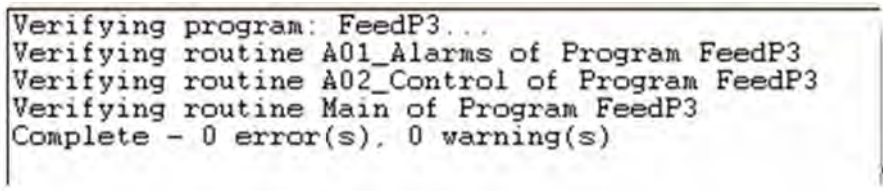
Required Pump I/O

I_FeedP3_Fault	WWTP_CLX_RACK02_Slot00_CNB:I.Slot[1].Data.6
I_FeedP3_Fault_IOFault	WWTP_CLX_RACK02_Slot00_CNB:I.Slot[1].Fault.6
I_FeedP3_InAuto	WWTP_CLX_RACK02_Slot00_CNB:I.Slot[1].Data.4
I_FeedP3_InAuto_IOFault	WWTP_CLX_RACK02_Slot00_CNB:I.Slot[1].Fault.4
I_FeedP3_OverLoad	WWTP_CLX_RACK02_Slot00_CNB:I.Slot[1].Data.7
I_FeedP3_OverLoad_IOFault	WWTP_CLX_RACK02_Slot00_CNB:I.Slot[1].Fault.7
I_FeedP3_RunFdbk	WWTP_CLX_RACK02_Slot00_CNB:I.Slot[1].Data.5
I_FeedP3_RunFdbk_IOFault	WWTP_CLX_RACK02_Slot00_CNB:I.Slot[1].Fault.5
I_FeedP3_SpeedFdbk	WWTP_CLX_RACK02_Slot00_CNB:4:I.Ch3Data
I_FeedP3_SpeedFdbk_IOFault	WWTP_CLX_RACK02_Slot00_CNB:4:I.Ch3Fault

Be sure to alias all the I/O to the new points for the additional pump. Be certain that all inputs and outputs are aliased to the correct location.

6. Verify the new routines verify and ensure that they contain no errors. The most commonly overlooked issues will be reconciling all the tags used in the routine. The ladder diagram itself will likely verify since this is a duplicate of another function routine.

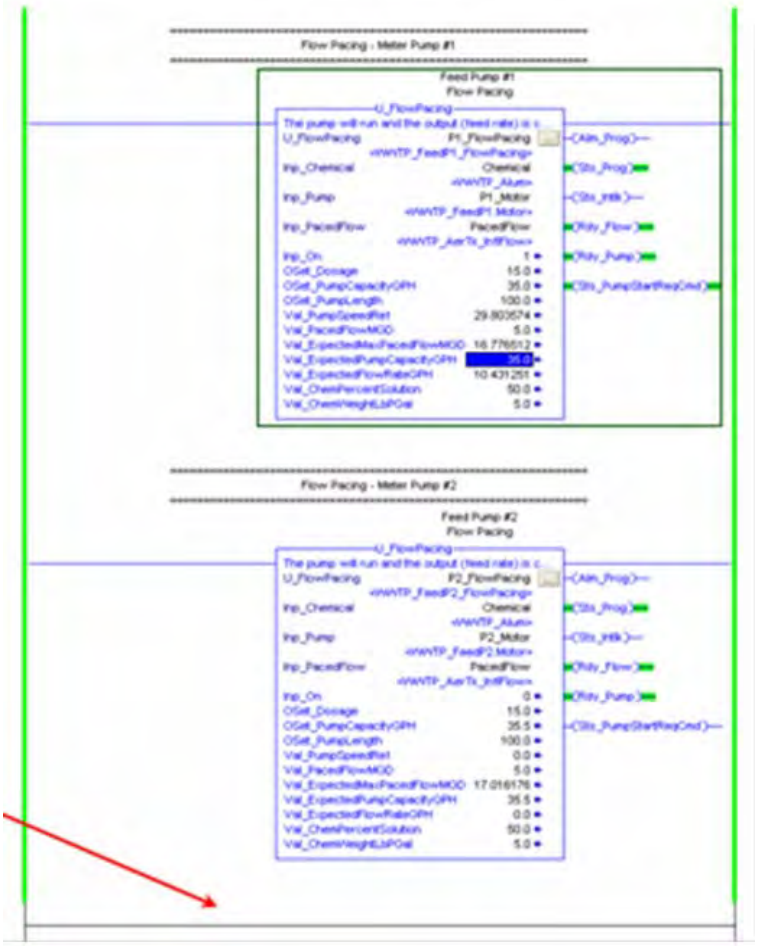
Pump I/O Verification Screen


Verifying program: FeedP3...
Verifying routine A01_Alarms of Program FeedP3
Verifying routine A02_Control of Program FeedP3
Verifying routine Main of Program FeedP3
Complete - 0 error(s), 0 warning(s)

Additional Flow Pacing

To include additional flow pacing for other pumps, add rungs to routine A01_Control in program FeedPSys. Each pump with flow pacing requires a U_FlowPacing AOI on its own rung. Add additional rungs below the existing Flow Pacing rungs as shown in the Adding Rungs To The FeedPSys Program AO1_Control illustration.

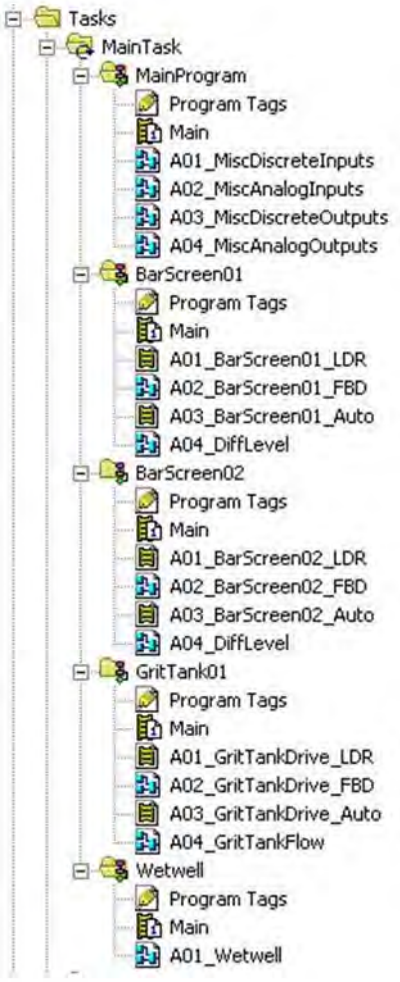
Adding Rungs to the FeedPSys Program A01_Control



Headworks Application

The Headworks application is provided on the WWWAT CD. Refer to the Headworks System Application Controller Organization illustration to view the application's organization within the Controller.

Headworks System Application Controller Organization



This task should reside in a Controller in the main facility of the plant where the Headworks application is present and it is not intended to be the only application in the Controller. A ControlLogix processor is specified for this application for that specific reason. It is assumed the processor will be running other systems of the plant.

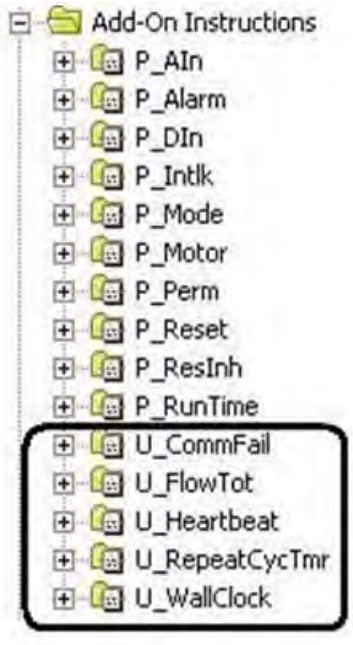
The organization of this application is similar to that of the Lift Station. Specifically, the functionality for each program and routine is:

- Main Program handles general Headworks application and functionality, including:
  - Main routine calls the other routines in this program and includes a Wall Clock AOI that calculates the day of the week.It also includes a Pump Inputs simulation bit that you can use when testing the application.
  - A01_MiscDiscreteInput includes a template to map inputs that are relevant throughout the Headworks system. This routine is provided as a Function Block Diagram.
  - A02_MiscAnalogInput includes a template to map analog inputs that are relevant throughout the Headworks system. This routine is provided as a Function Block Diagram.
  - A03_MiscOutputs includes a template to map outputs that are relevant throughout the Headworks system.
- BarScreen01 controls the motor, manages cycle times, and Flow Channel Differential levels for the Bar screen 1 system, including:
  - Main routine calls the other routines in this program.
  - A01_BarScreen01_LDR contains the code to monitor and control the Bar Screen 01 motor and reset alarms, interlocks, and faults associated with the motor. This routine is provided as a Ladder Diagram.
  - A02_BarScreen01_FBD contains the Single Speed Motor, Permissives and Interlock AOIs that monitor and control the Bar Screen 01 motor. This routine is provided as a Function Block Diagram.
  - A03_BarScreen01_Auto contains the Cycle Timer (including the U_RepeatCycTmr AOI) and High Differential Alarm code. This routine is provided as a Ladder Diagram.
  - A04_DiffLevel contains the Analog Input AOI that monitors the differential pressure levels of Preliminary Treatment Flow Channel No 1. This routine is provided as a Function Block Diagram.
- BarScreen02 Controls the motor and manages cycle times and flow channel differential levels for the Bar Screen 2 system as described for BarScreen01 above.
- GritTank01 Controls the motor and manages cycle times for the GritTank01 system, including:
  - Main routine calls the other routines in this program.
  - A01_GritTankDrive_LDR contains the code to monitor and control the Bar Screen 01 motor and reset alarms, interlocks and faults associated with the motor. This routine is provided as a Ladder Diagram.

  - A02_GritTankDrive_FBD contains the Single Speed Motor, Permissives and Interlock AOIs that monitor and control the Grit Tank 01 motor. This routine is provided as a Function Block Diagram.
  - A03_GritTankDrive_Auto contains the Cycle Timer (including the U_RepeatCycTmr AOI) code. This routine is provided as a Ladder Diagram.
  - A04_GritTankFlow contains the Analog Input AOI and U_FlowTot AOI that aggregates the Grit Tank 01 flow. This routine is provided as a Function Block Diagram.
- Wet well monitors Wet well level and generates alarms, including:
  - Main routine calls the other routines in this program.
  - A01_Wellwell contains the code to monitor Wet Well level and generates alarms utilizing the Analog (P_AIn) and Discrete (P_Din) Input AOIs. This routine is provided as a Function Block Diagram.

AOIs are used extensively in this application. There is a collection of Process Library AOIs and a collection of other AOIs developed specifically for this application. Process Library AOIs can be identified by a prefix "P_" in their name. The other AOIs have a prefix of "U_" as shown in the AOI illustration.

AOIs



Process Description

The Headworks treatment consists of Screening, Influent Flow Measurement, and Grit Removal. From the inlet well, the wastewater enters one or two preliminary treatment flow channels. Each flow channel consists of an

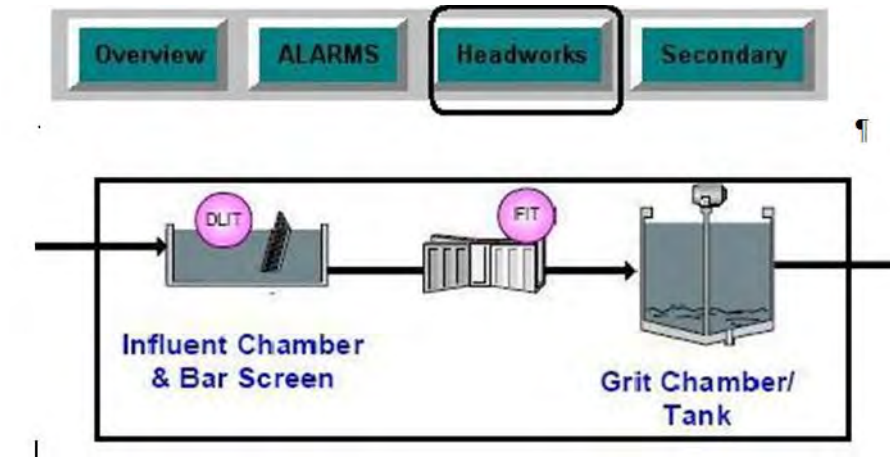
Inclined Bar screen with a mechanical raking device to remove debris from the raw wastewater. The **Mechanical Bar** screens cycle periodically to rake debris from the bar rack and deposit the screenings on a belt conveyor. This conveyor runs during the screening cycle and moves the screenings to the Screenings Compactor which empties into the grit and screen hopper for subsequent disposal.

HMI Description

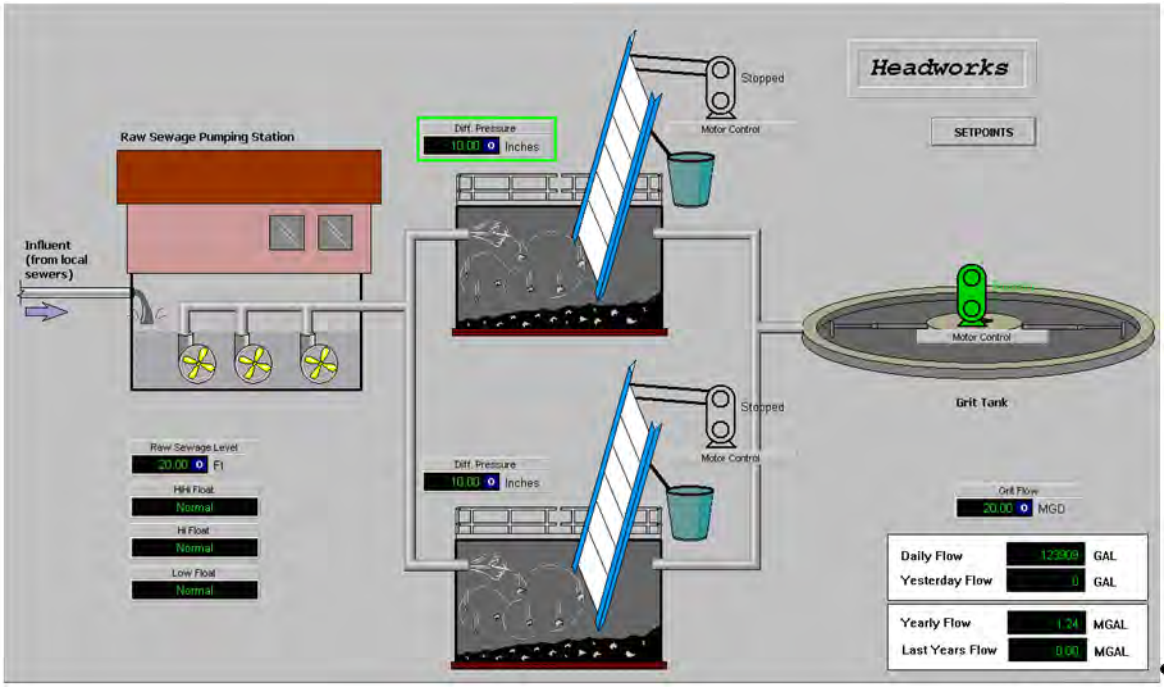
The operator controls and monitors these processes as follows:

1. Go to the **Overview** screen.
2. Click the **Headworks** button or the **Headworks** icon to display the **Headworks Application** screen.

Selecting the Headworks Button



Headworks/Primary Treatment Overview Screen



The status information on the **Headworks/Primary Treatment Overview** screen includes:

- **Mechanical Bar** screen Numbers.1 and 2
- Grit Tank Drive No. 1
- Channel Numbers 1 and 2, Differential Level
- Channel Number 1 Flow

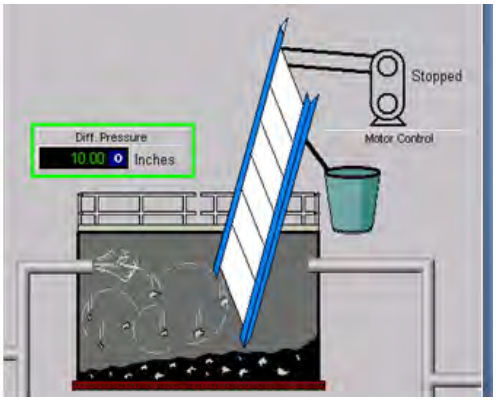
Control Description - Mechanical Bar Screen Numbers 1 and 2

This section describes the **Mechanical Bar** screen modes.

Hand Mode

The **Mechanical Bar** screens Number 1 and Number 2 are operated locally by selecting the **Hand** position on the **Hand-Off-Auto** selector switch, which is located at the MCC. The operator uses the BAR screen buttons located at the equipment. In this mode, the operator is responsible for operating the conveyor, compactor, and the **Bar** screen.

Mechanical Bar Screen



Remote Operator Mode

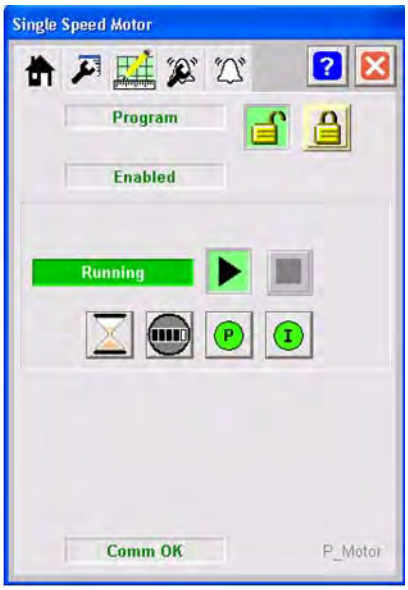
The operator must place the screening equipment in the this mode to use it from the **HMI**. The operator can place the Mechanical Bar screen in the **Remote** mode by selecting **Auto** on the **Auto-Off-Hand** selector switches located at the MCC for each equipment.

In **Remote** mode, the operator may select **Auto** or **Manual** mode to control the process from the HMI.

Operator Mode (Manual)

Click the screening equipment to display the **Single Speed Motor Faceplate** screen.

Single Speed Motor Faceplate Screen (HMI Template)



For **Manual Operator Control**, select the **Operator** mode from the HMI equipment Faceplate. The Faceplate shown is used to control the screening equipment. The screening equipment is started and stopped remotely from the **HMI** screen. The available **Bar** screen commands include:

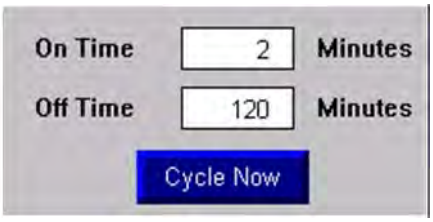
- Press the **Play** button to start the **Bar** screen.
- Press the **Stop** button to stop the **Bar** screen.
- Click the **Disable** button to remove the Bar screen from service.
- Click the **Enable** button to place the unit back in service.

Program Mode (Auto)

To place the **Bar** screen in **Program Mode (Auto)** control, perform the following:

1. Select **Auto** on the **Auto-Off-Hand** selector switches located at the MCC for each equipment to place the **Bar** screen in the **Remote** mode.
2. Select **Program** mode from the **HMI Faceplate** template. When in **Remote Program** mode, the screening will be called to start when the accumulated time is equal to the Cycle Timer pre-set or the differential level across the screen reaches setpoint.

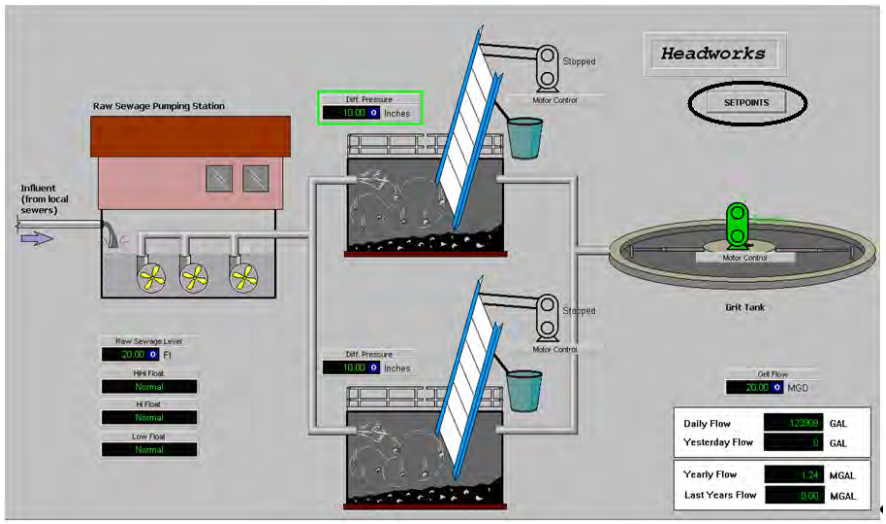
Bar Screen Cycle Timer



The following sequence will occur when the screening system is run in Auto:

1. The system commands the **Mechanical Bar** screen to start.
2. The **Mechanical Bar** screen will run for 2 minutes before being called to stop.
3. The operator can access the Control Setpoints by selecting the **Setpoints** button on the **Headworks/Primary Treatment Overview** screen.

Setpoints Button Location



Grit Removal

This section describes the **Grit Removal, Hand, Remote Operator,** and **Program** modes.

Hand Mode - Grit Tank Drive (GTD) No. 1

Operate the drive in the **Local** mode by selecting **Hand** on the **Hand-Off-Auto** selector switch located at the MCC. The operator uses the buttons located at the tank to start or stop each drive.

Grit Tank Drive

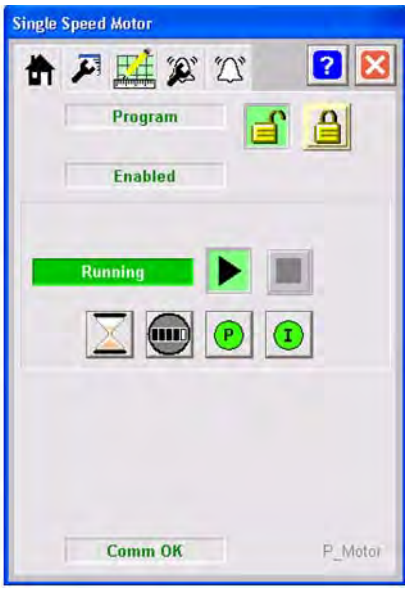
Remote Operator Mode

The operator must place the Grit Tank Drive in the **Remote Operator** mode to use it from the HMI. The Grit Tank Drive is placed in the **Remote** mode by selecting **Auto** on the **Auto-Off-Hand** selector switches located at the MCC for each equipment. In the **Remote** mode, the operator may select **Auto** or **Manual** mode to control the process from the **HMI**.

Operator Mode (Manual)

Once the operator clicks on the GTD equipment, the system displays a Faceplate screen.

HMI Equipment Faceplate Screen



The operator uses this Faceplate screen to control the GTD equipment. For **Manual Operator Control,** select the **Operator** mode from the **HMI** equipment Faceplate.

The operator starts/stops the **GTD** equipment remotely from the HMI screen. The available GTD screen commands include:

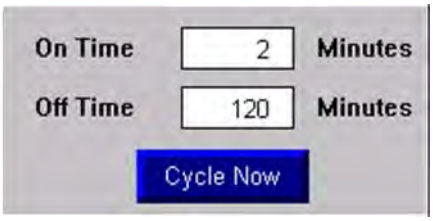
- Press the **Play** button to start the **GTD** screen.
- Press the **Stop** button to stop the **GTD** screen.
- Click the **Disable** button to remove the **GTD** screen from service.
- Click the **Enable** button to place the unit back in service.

Program Mode (Auto)

To place the GTD equipment in **Remote Program Mode (Auto)** control, perform the following:

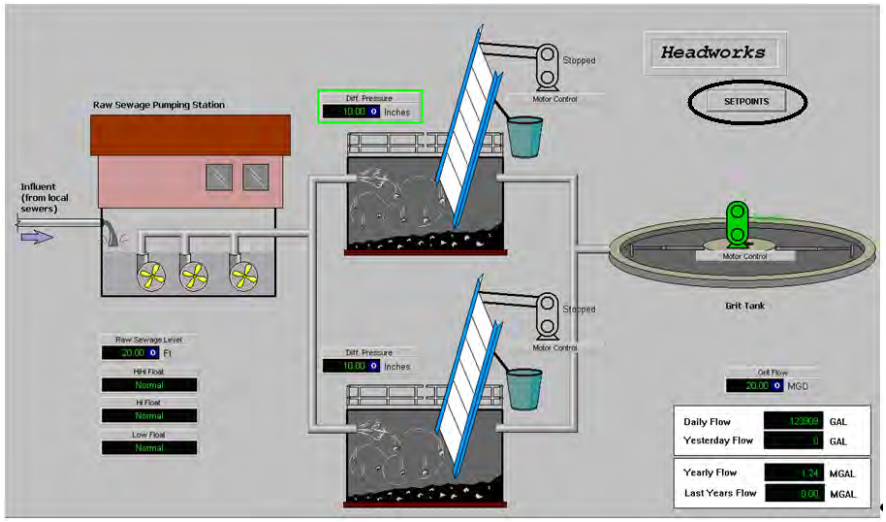
1. Select **Auto** on the **Auto-Off-Hand** selector switches located at the MCC for each equipment to place the GTD equipment in the **Remote** mode.
2. Select **Program** mode from the **HMI Faceplate** template. When in **Remote Program** mode, the system calls the GTD equipment to start when the accumulated time is equal to the Cycle Timer pre-set.

Bar Screen Cycle Timer



3. The operator can access the Control Setpoints by selecting the **Setpoints** button on the **Headworks/Primary Treatment Overview** screen.

Setpoints Button Location



Alarms

The Supervisory Control and Data Acquisition (SCADA) system generates these two types of alarms.

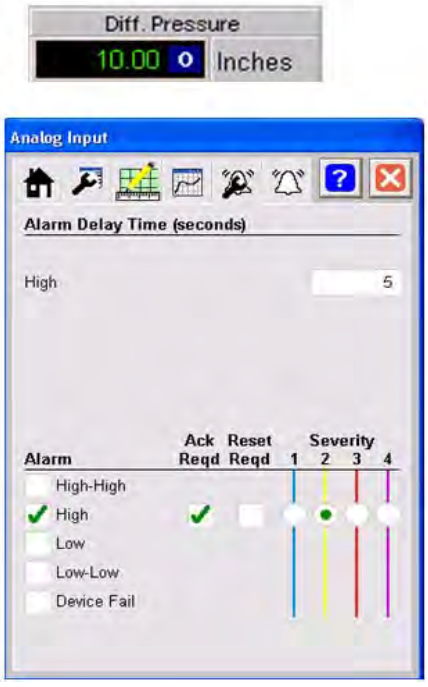
- Process
- Equipment

Process Alarms

There are the six types of Process Alarms.

- Channel No. 1 Differential Level High Alarm
- Channel No. 2 Differential Level High Alarm
- Wet well Level High Alarm
- Wet well Level Low Alarm
- Wet well Float High High Alarm
- Wet well Float High Alarm
- Wet well Float Low Alarm

Process Alarms



Equipment Alarms

These are the two types of Equipment Alarms.

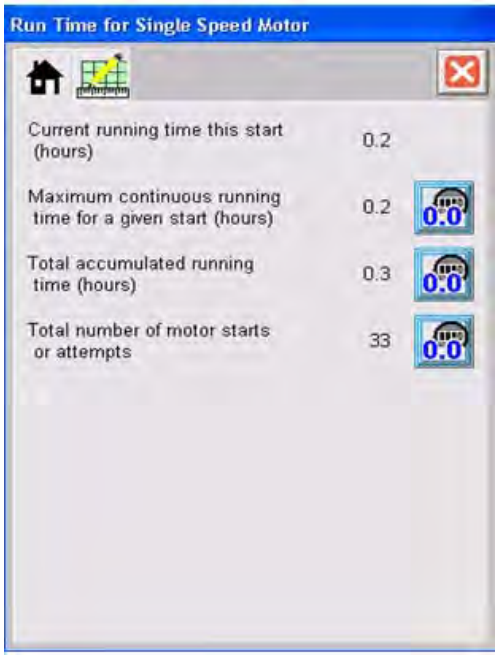
- **Start/Stop Faults** - If the system calls the **Mechanical Bar** screen and it is not running after 5 seconds, he system generates a **Start/Stop Fail Alarm** and displays it at the **HMI**.
- **Start/Stop Faults** - If the system calls the GTD to start and is not running after 5 seconds, the system generates a **Start/Stop Fail Alarm** and displays it at the HMI.

Reporting Equipment Run Times

Run times are recoded for the **Mechanical Bar** screen mechanism by the SCADA system. Depending on the user's security level, the total run time maybe reset by clicking on the **Total Reset** button next to the appropriate pump.

- Mechanical Bar Screen Numbers 1 and 2
- Grit Tank Drive Number 1

Single Speed Motor Run Time



Customization of the Headworks Application

General customization notes are included in the Lift Station Application section (page 102) of this chapter. Refer to this section before customizing any application, including the Headworks. This section describes customization specific to the Headworks application.

I/O Assignment

As in the Lift Station, I/O is mapped into this application. This is done in the following project locations:

- MainProgram - A01_DiscreteInput - as needed - this routine is provided as a template.
- MainProgram - A02_AnalogInput - as needed - this routine is provided as a template.
- MainProgram - A03_Outputs - as needed - this routine is provided as a template.

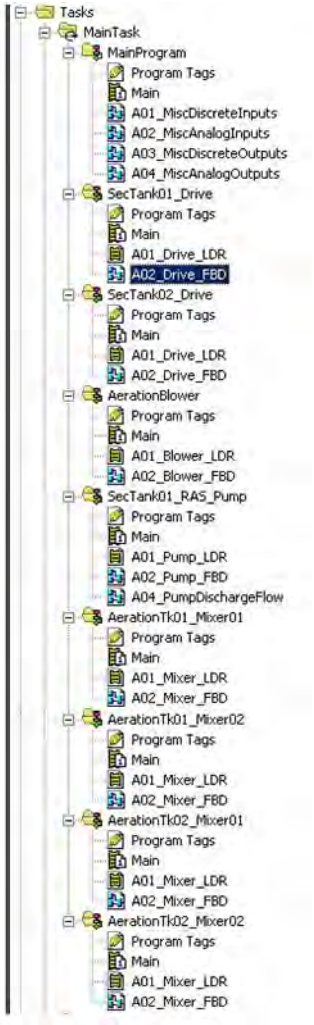
Additional Pumps/Motors (Single Speed Motor AOIs in a FBD Routine)

See the Customization of the Solids Application section for an example of how to add Single Speed Motor AOIs in a FBD routine.

Secondary Application

The WWWAT CD contains the Secondary application. Refer to the Secondary System Application Controller Organization illustration to view the application's organization within the Controller.

Secondary System Application Controller Organization



This task resides in a Controller in the main facility of the plant where the Secondary application is present and it is not intended to be the only application in the Controller. A ControlLogix processor is specified for this application for that specific reason. It is assumed the processor will be running other systems of the plant.

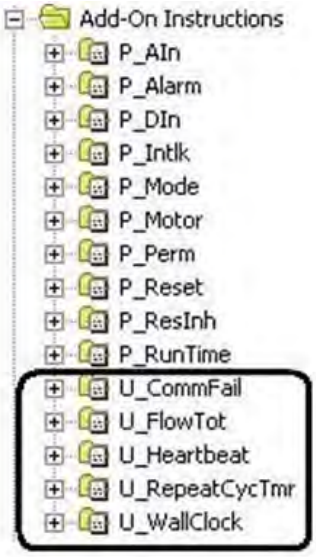
The organization of this application is similar to that of the Lift Station. Specifically, the functionality for each program and routine is:

- Main Program handles general Secondary application and functionality, including:
  - Main routine calls the other routines in this program and includes a Wall Clock AOI that calculates the day of the week.It also includes a Pump Inputs simulation bit that you can use when testing the application.
  - A01_MiscDiscreteInput includes a template to map inputs that are relevant throughout the Secondary system. This routine is provided as a Function Block Diagram.
  - A02_MiscAnalogInput includes a template to map analog inputs that are relevant throughout the Secondary system. This routine is provided as a Function Block Diagram.
  - A03_MiscOutputs includes a template to map outputs that are relevant throughout the Secondary system. This routine is provided as a Function Block Diagram.
- SecTank01_Drive Controls the motor for the Secondary Clarifier Tank 1 system, including:
  - Main routine calls the other routines in this program.
  - A01_Drive _LDR contains the code to monitor and control the Secondary Tank 01 motor and Reset Alarms, Interlocks, and Faults associated with the motor. This routine is provided as a Ladder Diagram.
  - A02_Drive_FBD contains the Single Speed Motor, Permissives, and Interlock AOIs that monitor and control the Secondary Tank 01 motor. (See the Using Add-On Instructions section above for more information.) This routine is provided as a Function Block Diagram.
- SecTank 02_Drive Controls the motor for the Secondary Clarifier Tank 2 system as described for the Secondary Clarifier Tank 1.
- Aeration Blower Controls the motor for the Blower system, including:
  - Main routine calls the other routines in this program.
  - A01_Blower _LDR contains the code to monitor and control the Blower motor and Reset Alarms, Interlocks, and Faults associated with the motor. This routine is provided as a Ladder Diagram.
  - A02_Blower_FBD contains the Single Speed Motor, Permissives and Interlock AOIs that monitor and control the Blower motor (See the Using Add-On Instructions section above for more information). This routine is provided as a Function Block Diagram.
- SecTank01_RAS Pump Controls the Variable Speed Drive for the RAS Pump, including:
  - Main routine calls the other routines in this program.
  - A01_Pump_LDR contains the code to monitor and control the VFD for the RAS Pump, Reset Alarms, Interlocks, and Faults associated with the pump. This routine is provided as a Ladder Diagram.

  - A02_Pump_FBD contains the Variable Speed Drive, Permissives, and Interlock AOIs that monitor and control the RAS Pump (See the Using Add-On Instructions section above for more information). This routine is provided as a Function Block Diagram.
  - A04_PumpDischargeFlow contains the Analog Input AOI and U_FlowTot AOI that totalizes the RAS pump discharge flow. This routine is provided as a Function Block Diagram.
- AerationTk01_Mixer01 Controls the motor and manages cycle times and flow channel differential levels for the Aeration Tank 1 Mixer 1 system, including:
  - Main routine calls the other routines in this program.
  - A01_Mixer _LDR contains the code to monitor and control the Aeration Tank 1 Mixer 1 Reset Alarms, Interlocks, and Faults associated with the motor. This routine is provided as a Ladder Diagram.
  - A02_Mixer_FBD contains the Single Speed Motor, Permissives, and Interlock AOIs that monitor and control the Aeration Tank 1 Mixer 1 motor (See the Using Add-On Instructions section above for more information). This routine is provided as a Function Block Diagram.
- AerationTk01_Mixer02 Controls the motor for the Aeration Tank 1 Mixer 2 system as described for the Aeration Tank 1 Mixer 1 system.
- AerationTk02_Mixer01 Controls the motor for the Aeration Tank 2 Mixer 1 system as described for the Aeration Tank 1 Mixer 1 system.
- AerationTk02_Mixer02 Controls the motor for the Aeration Tank 2 Mixer 2 system as described for the Aeration Tank 1 Mixer 1 system.

Add-On Instructions are used extensively in this application. There is a collection of Process Library AOIs and a collection of other AOIs developed specifically for this application. Process Library AOIs can be identified by a prefix "P_" in their name. The other AOIs have a prefix of "U_" as shown in the AOI illustration.

AOIs



Process Description

The Secondary application consists of an aeration tank, blower, RAS pump, and a Secondary Clarifier tank.

Aeration Tank

Effluent from the Primary Settling Tanks (primary effluent) contains soluble and colloidal impurities which were not removed in the preliminary and primary treatment processes. Secondary treatment, employing the activated sludge process with biological phosphorus removal, removes most of these impurities before the wastewater is filtered, disinfected, and discharged.

Blower

In the activated sludge treatment process, oxygen is required to maintain aerobic conditions for the treatment process. If an adequate air supply is not maintained, such that the available dissolved oxygen (DO) satisfies the biochemical oxygen demand (BOD), the organisms will fail to reproduce effectively, and may perish due to lack of oxygen, in which case adequate treatment will not be provided.

Return Activated Sludge (RAS) Pump

A RAS pump is located near the Secondary Clarifier Settling Tank (SCST). The RAS pumps remove the aerated sludge that accumulates on the bottom of the SCST. The pumps discharge into the Aeration Tank's Anoxic Zone where RAS is mixed with primary effluent.

Secondary Clarifier Settling Tank

The mixed liquor flows from the Aeration Tanks effluent channel to the SCST. In the SCST, many of the solids are settled out while the effluent exits over weirs and flows to the Secondary Effluent Pumping Station in the Tertiary Filter Building. The purpose of the SCST is primarily to produce a clarified effluent with a secondary objective of removing and returning sludge to the system.

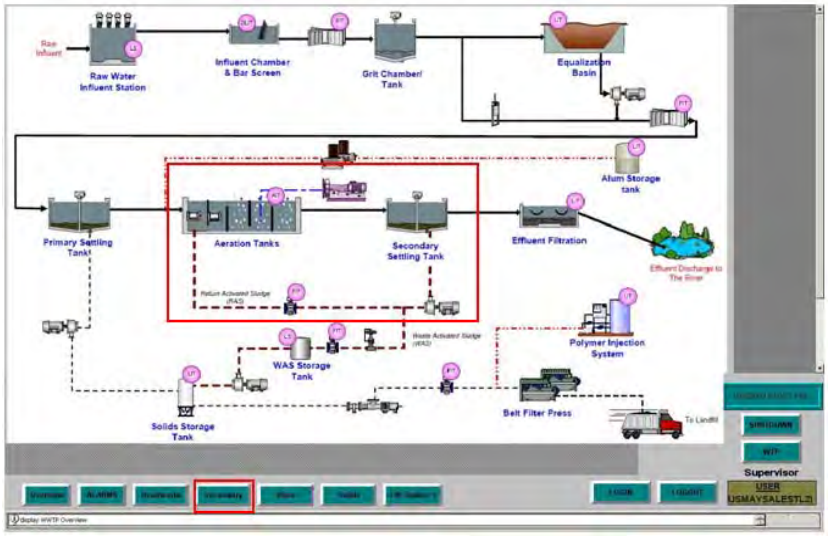
The SCST is part of a discrete process train, including a Primary Clarifier, Aeration Tank, and a SCST. Flow from a Primary Clarifier flows into a corresponding Aeration Tank and then into the corresponding SCST.

HMI Description

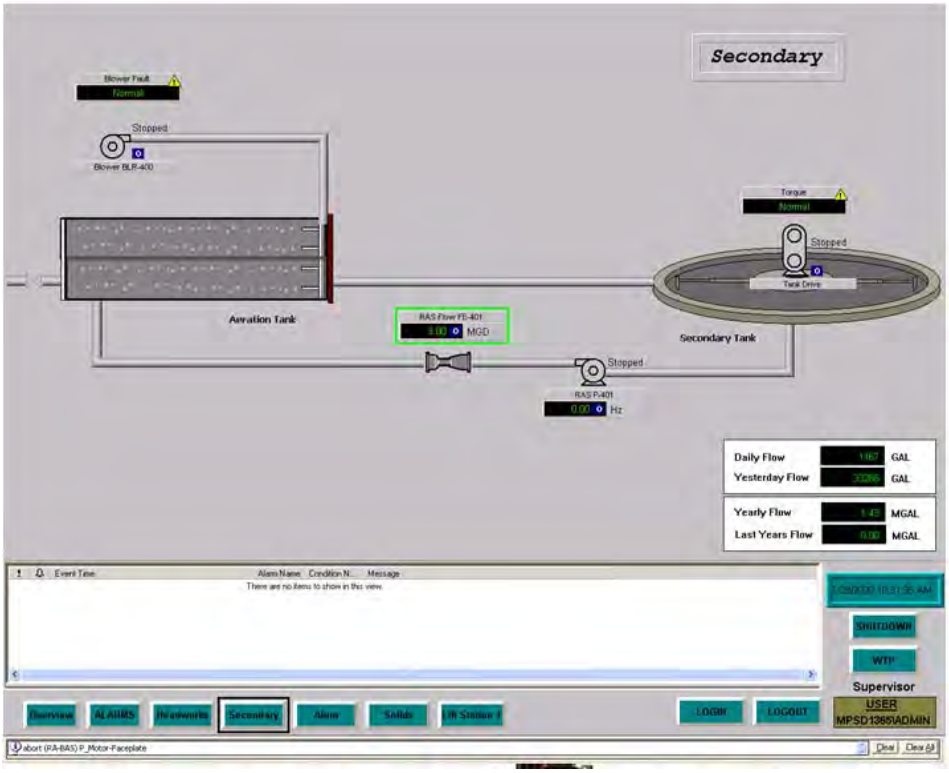
The operator controls and monitors these processes as follows:

1. Go to the **Wastewater Treatment Plant (WWTP) Overview** screen.
2. Click the **Secondary** button or the **Secondary** icon to display the **Secondary Overview** screen.

Selecting the Secondary Overview Screen



Secondary Overview Screen



The status information on the **Secondary Overview** screen includes:

- Blower BLR-400
- Secondary Clarifier Setting Tank 1
- RAS Pump P-401
- Return Flow Rate FIT-401

Control Description - Blower BLR-400

This section describes the BLR-400 Blower modes.

Hand Mode

Select **Hand** on the **Hand-Off-Auto** selector switch (located at the MCC) to operate the blower locally. The operator uses the buttons located at the equipment to operate the blower.

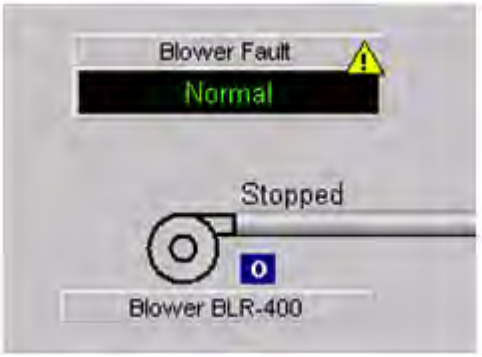
Remote Operator Mode

Select the Auto position on the Auto-Off-Hand selector switches located at the MCC to put the BLR-400 Blower in the Remote mode.

Operator Mode (Manual)

Click on the BLR-400 Blower section of the **Secondary Overview** screen.

Selecting Blower BLR-400 on the Secondary Overview Screen



The system displays the **Blower BLR-400 Faceplate**.

Blower BLR-400 Faceplate

For manual Operator Control, select the **Operator** mode on the **BLR-400 Blower Faceplate**. The Faceplate shown is used to control the blower. The operator starts and stops the blower remotely from the **BLR-400 Blower Faceplate**, selecting the BLR-400 icon on the **Secondary Overview** Screen. The available Faceplate commands include:

- Press the **Play** button to start the blower.
- Press the **Stop** button to stop the blower.
- Click the **Disable** button to remove the blower from service.
- Click the **Enable** button to place the unit back in service.

RAS Pump

The RAS pumps are Variable Frequency Drive-controlled (VFD), which allows their speed to be throttled. The flow of the RAS is controlled by varying the speed of these pumps. There will be one pump for each secondary Clarifier Tank.

Hand Mode

Select Hand on the Hand-Off-Auto selector switch (located at the VFD) to operate the pump locally. The operator uses the buttons located at the VFD to operate the pump.

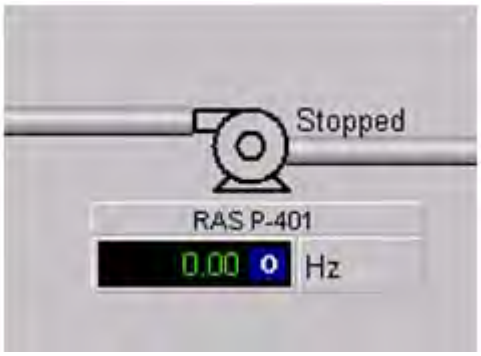
Remote Operator Mode

Select the Auto position on the Auto-Off-Hand selector switches located at the VFD to put the RAS Pump in the Remote mode.

Operator Mode (Manual)

Click on the RAS Pump section of the **Secondary Overview** screen.

Selecting the RAS Pump on the Secondary Overview Screen



The system displays the **Blower RAS P-401 Faceplate**.

RAS Pump P-401 Faceplate

For manual Operator Control, select the **Operator** mode on the **RAS P-401 Pump Faceplate**. The Faceplate shown is used to control the RAS pump. The operator starts and stops the pump remotely from the **RAS P-401 Pump Faceplate**, selecting RAS P-401 on the **Secondary Overview** screen. The available Faceplate commands include:

- Press the **Play** button to start the pump.
- Press the **Stop** button to stop the pump.
- Click the **Disable** button to remove the pump from service.
- Click the **Enable** button to place the unit back in service.

Secondary Clarifier Tank

Plant operators manually control the Secondary Clarifier Tank (SCT). The SCT center drive runs continuously and is protected from over-torque by overload switches set at the factory. The overload switches sense a build up of torque as the mechanism rotates. A factory pre-set overload switch will trip the Final Tank Mechanism Overload (common alarm), as the torque builds up. Further increasing torque will cause a second factory pre-set switch to trip and stop the mechanism from running. When the mechanism stops due to an overload or a power outage, the operator must restart the unit manually.

Hand Mode

Select Hand on the Hand-Off-Auto selector switch (located at the MCC) to operate the SCT locally. The operator uses the buttons located at the MCC to operate the SCT.

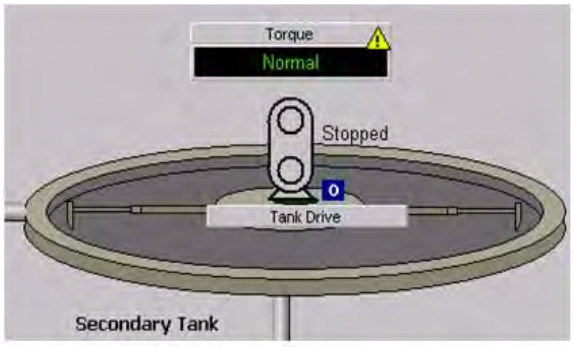
Remote Operator Mode

Select the Auto position on the Auto-Off-Hand selector switches located at the MCC to put the SCT in the Remote mode.

Operator Mode (Manual)

Click the SCT section of the **Secondary Overview** screen.

Selecting the SCT on the Secondary Overview Screen



The system displays the **Tank Drive Faceplate**.

Tank Drive Faceplate

For manual Operator Control, select the **Operator** mode on the **Tank Drive Faceplate**. The Faceplate shown is used to control the Tank Drive. The operator starts and stops the drive remotely from the **Tank Drive Faceplate**, selecting **Tank Drive** on the **Secondary Overview** screen. The available Faceplate commands include:

- Press the **Play** button to start the drive.
- Press the **Stop** button to stop the drive.
- Click the **Disable** button to remove the drive from service.
- Click the **Enable** button to place the unit back into service.

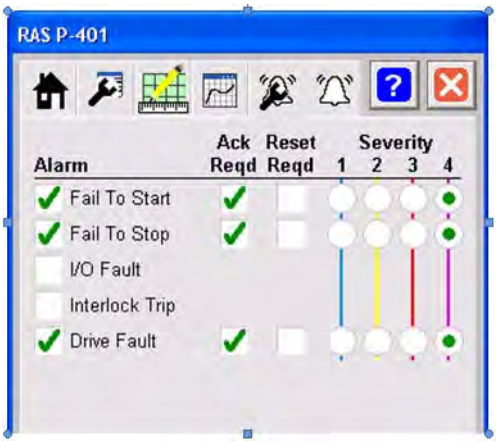
Alarms

The Supervisory Control and Data Acquisition (SCADA) system generates the following equipment alarms:

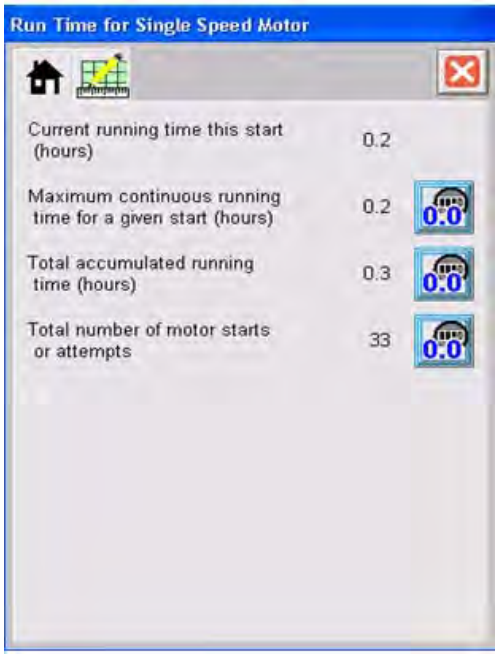
- **Start/Stop Faults**
  - If the blower is called to start and is not running after 5 seconds, the HMI generates a Start/Stop Fail alarm.
  - If the RAS pump is called to start and is not running after 5 seconds, the HMI generates a Start/Stop Fail alarm.
  - If the SCT center drive is called to start and is not running after 5 seconds, the HMI generates a Start/Stop Fail alarm.
- **Blower Fault** - This is a contact from the blower starter control panel, and once opened, the HMI generates a Blower Fault alarm.

- **SCT Center Drive Fault** This is a contact from the center drive mechanism, and once opened, the HMI generates a SCT 1 Center Drive Mechanism Fault Alarm.
- **RAS Pump VFD Fault** - This is a messaged fault from the VFD drive unit. Once the PLC receives the fault message, the HMI generates a VFD alarm.

RAS P-401 Alarms



Single Speed Motor Run Time

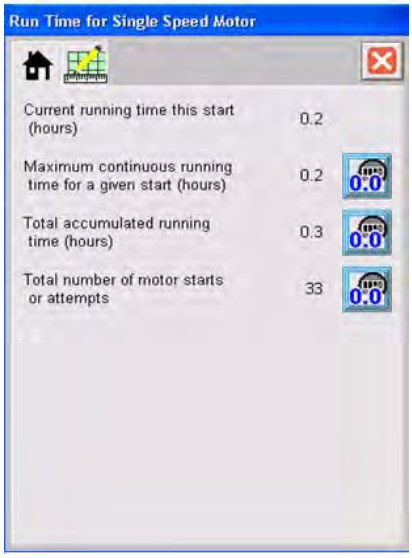

Run Time for Single Speed Motor
Current running time this start (hours)
0.2
Maximum continuous running time for a given start (hours)
0.2
Total accumulated running time (hours)
0.3
Total number of motor starts or attempts
33

Reporting

The SCADA system records:

- Process - The system will trend common signals and record them for future viewing, including:
  - RAS Pump P-401
  - Output Frequency
  - Command Frequency
- Equipment Run Times - Runtimes are recorded for the blower, SCT center drive mechanism, and RAS Pump P-401. Depending on the user's security level, the total run time may be reset by clicking on the **Total Reset** button next to the appropriate pump.

Single Speed Motor Run Time



Customization of the Secondary Application

General customization notes are included in the Lift Station Application section (page 102) of this chapter. Refer to this section before customizing any application, including the Secondary. This section describes customization specific to the Secondary application.

I/O Assignment

As in the Lift Station, I/O is mapped into this application. This is done in the following project locations.

- MainProgram - A01_DiscreteInput - as needed - this routine is provided as a template.
- MainProgram - A02_AnalogInput - as needed - this routine is provided as a template.
- MainProgram - A03_Outputs - as needed - this routine is provided as a template.

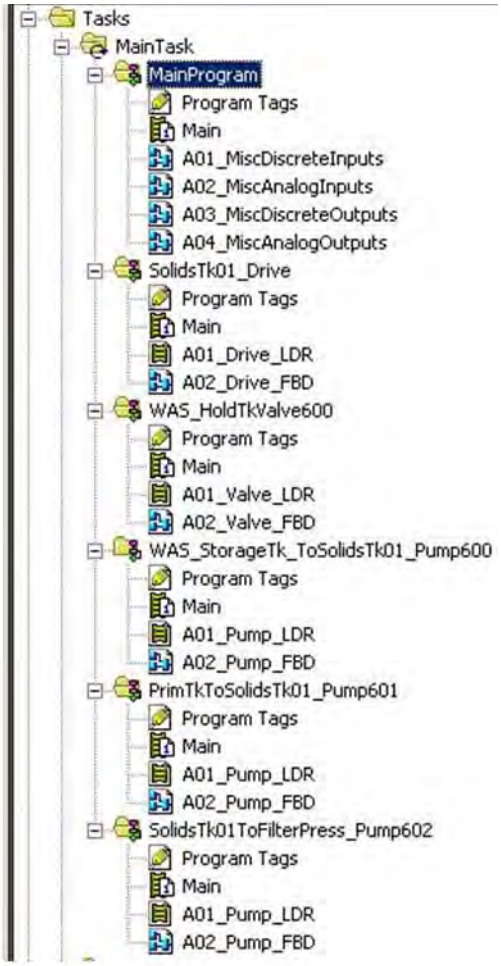
Additional Pumps/Motors (Single Speed Motor AOIs in a FBD Routine)

See the Customization of the Solids Application section for an example of how to add Single Speed Motor AOIs in a FBD routine.

Solids Application

The WWWAT CD contains the Solids application. Refer to the Solids System Application Controller Organization illustration to view the application's organization within the Controller.

Solids System Application Controller Organization



This task resides in a Controller in the main facility of the plant where the Solids application is present and it is not intended to be the only application in the Controller. A ControlLogix processor is specified for this application for that specific reason. It is assumed the processor will be running other systems of the plant.

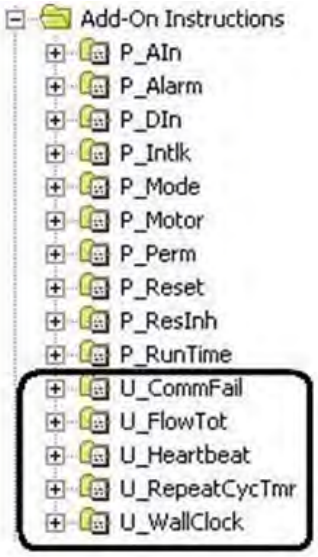
The organization of this application is similar to that of the Lift Station. Specifically, the functionality for each program and routine is:

- Main Program handles general Solids application and functionality:
  - Main routine calls the other routines in this program and includes a Wall Clock AOI that calculates the day of the week. It also includes a Pump Inputs simulation bit that you can use when testing the application.
  - A01_MiscDiscreteInput provides a template to map inputs that are relevant throughout the secondary. This routine is provided as a Function Block Diagram.
  - A02_MiscAnalogInput provides a template to map analog inputs that are relevant throughout the secondary. This routine is provided as a Function Block Diagram.
  - A03_MiscDiscreteOutputs provides a template to map outputs that are relevant throughout the secondary. This routine is provided as a Function Block Diagram.
  - A04_MiscAnalogOutput provides a template to map analog inputs that are relevant throughout the secondary. This routine is provided as a Function Block Diagram.
- SolidsTk01_Drive Controls the motor for the Solids Storage Tank Agitator.
  - Main routine calls the other routines in this program.
  - A01_Drive _LDR contains the code to map fault inputs, hand mode, and resets for the Solids Storage Tank Agitator motor. This routine is provided as a Ladder Diagram.
  - A02_Drive_FBD contains the Single Speed Motor, Permissives, and Interlock AOIs that monitor and control the Solids Storage Tank Agitator motor. (See the Using Add-On Instructions section for more information.) This routine is provided as a Function Block Diagram.
- WAS_HoldTkValve600 controls the Waste Activated Sludge (WAS) Valve.
  - Main routine calls the other routines in this program.
  - A01_Valve _LDR contains the code to map fault inputs, hand mode, and resets for the Waste Activated Sludge (WAS) valve. This routine is provided as a Ladder Diagram.
  - A02_Valve_FBD contains the Motor Operated Valve and Permissives (AOIs that monitor and control the Waste Activated Sludge (WAS) valve. (See the Using Add-On Instructions section for more information). This routine is provided as a Function Block Diagram.
- WAS_StorageTk_ToSolidsTk01_Pump600 controls the motor for the WAS Storage Tank to Solids Storage Tank pump.
  - Main routine calls the other routines in this program.

  - A01_Pump_LDR contains the code to map fault inputs, hand mode, and resets for the WAS Storage Tank to Solids Storage Tank pump. This routine is provided as a Ladder Diagram.
  - A02_Pump_FBD contains the Single Speed Motor, Permissives, and Interlock AOIs that monitor and control the WAS Storage Tank to Solids Storage Tank pump. (See the Using Add-On Instructions section for more information.) This routine is provided as a Function Block Diagram.
- PrimTkToSolidsTk01_Pump601 Controls the motor for the Primary Tank to Solids Tank pump.
  - Main routine calls the other routines in this program.
  - A01_Pump _LDR contains the code to map fault inputs, hand mode, and resets for the Primary Tank to Solids Tank pump. This routine is provided as a Ladder Diagram.
  - A02_Pump_FBD contains the Single Speed Motor, Permissives, and Interlock AOIs that monitor and control the Primary Tank to Solids Tank pump. (See the Using Add-On Instructions section for more information.) This routine is provided as a Function Block Diagram.
- SolidsTk01ToFilterPress_Pump602 controls the motor for the Solids Tank to Belt Filter Press pump.ar Screen 1 system.
  - Main routine calls the other routines in this program.
  - A01_Pump _LDR contains the code to monitor and control the Bar Screen 01 motor and Reset Alarms, Interlocks and Faults associated with the motor. This routine is provided as a Ladder Diagram.
  - A02_Pump_FBD contains the Single Speed Motor, Permissives, and Interlock AOIs that monitor and control the Bar Screen 01 motor. (See the Using Add-On Instructions section for more information.) This routine is provided as a Function Block Diagram.

Add-On Instructions are used extensively in this application. There is a collection of Process Library AOIs and a collection of other AOIs developed specifically for this application. Process Library AOIs can be identified by a prefix "P_" in their name. The other AOIs have a prefix of "U_" as shown in the AOI illustration.

AOIs



Process Description

The Solids Treatment application includes:

- Waste Activated Sludge (WAS) Valve
- Solids Storage Tank (SST)
- Solids Storage Tank Agitator (SSTA)
- Solids Transfer Pump (STP)

Waste Activated Sludge Valve

WAS is removed from the RAS discharge piping using a throttling valve. The throttling valve is controlled to provide the operated selected flow rate to the WAS holding tank.

Solids Storage Tank

The influent to the storage tank is comprised of primary solids (PS) and WAS. The contents are mixed by mechanical agitators. The Blending Tanks feed the dewatering system. A transfer pump, located in the basement of the Solids Building, is used to transfer the contents of the tank to the Belt Filter Press (BFP).

Solids Storage Tank Agitator

A Paddle Agitator mixing mechanism is provided in the tank to continually mix the tank contents prior to pumping. The mixing mechanism is used to minimize solids settling and to ensure that consistent feed solids characteristics are applied to the dewatering system.

Solids Transfer Pump

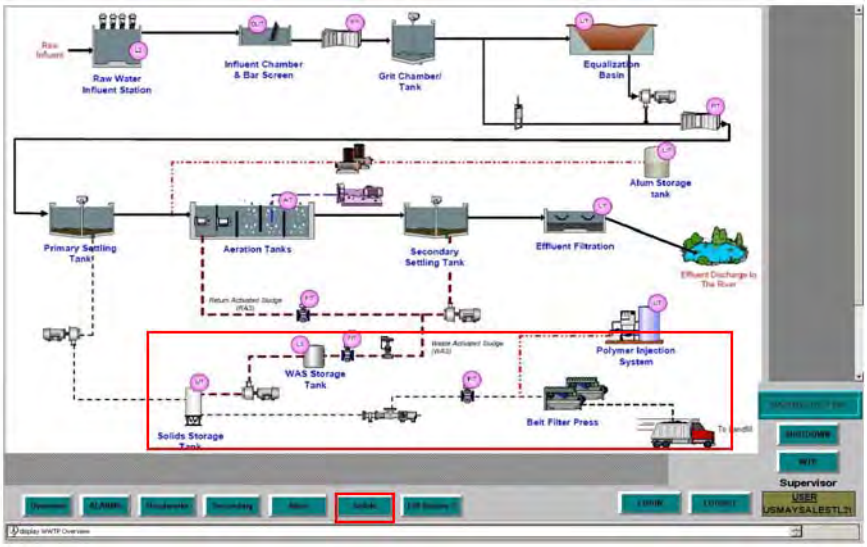
A transfer pump transfers blended solids from the storage tank to the BFP. Blended solids consist of PS and WAS. A grinder is located upstream of the BFP feed pump, and Pulsation Dampeners are located on the suction and discharge side of the pump. A flow meter is located on the discharge of the pump to the BFPs.

HMI Description

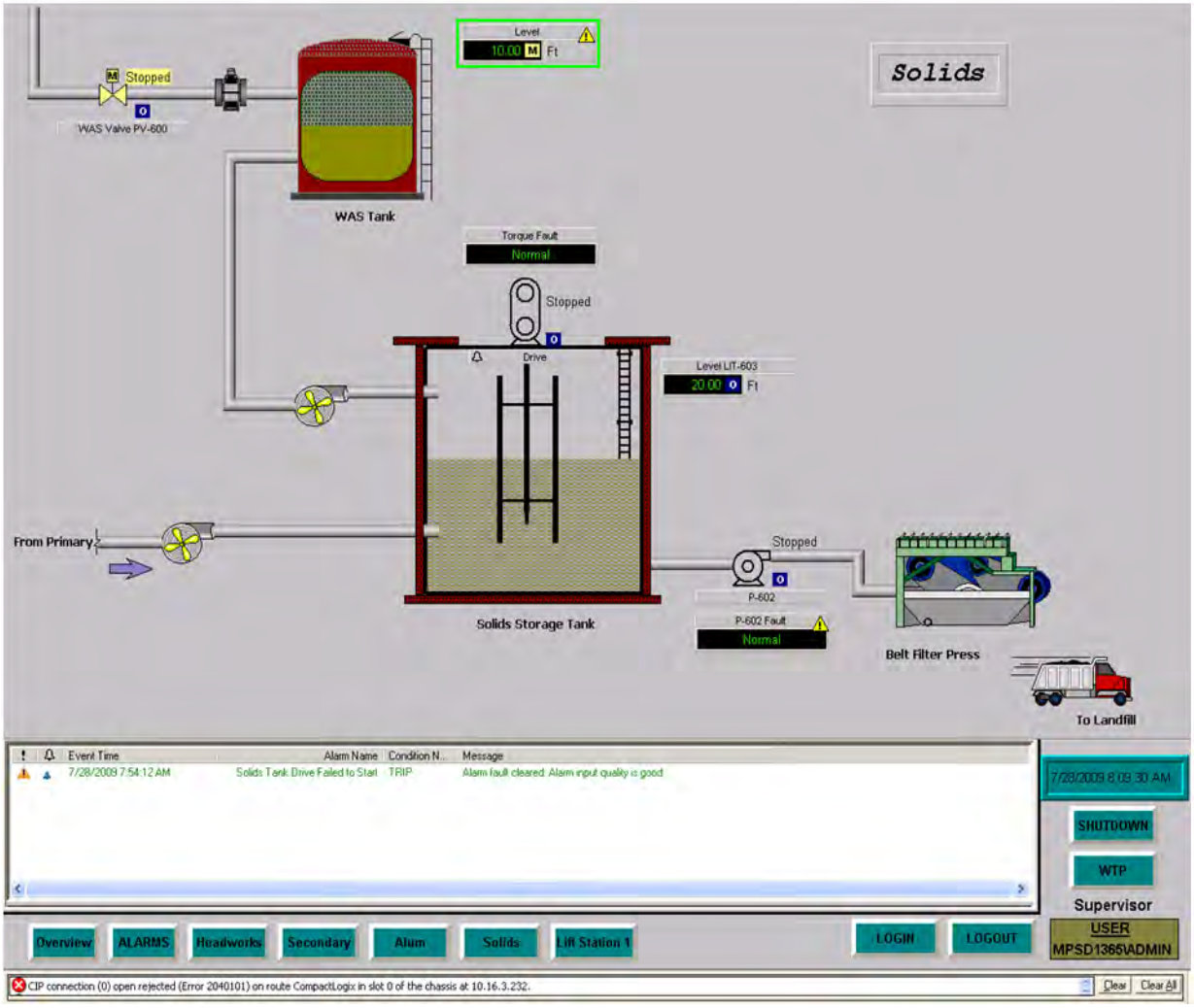
The operator controls and monitor these processes as follows:

1. Go to the **Wastewater Treatment Plant (WWTP) Overview** screen.
2. Click the **Solid**s button or one of the **Solids** icons to display the **Solids Overview** screen.

Selecting the Solids Overview Screen



Solids Overview Screen



The status information on the **Solids Overview** screen includes:

- WAS Valve PV-600
- WAS Flow Rate FIT-600
- WAS Tank Level
- Solids Storage Tanks Mixing Drive
- Solids Transfer Pump
- Solids Storage Tank Level LIT-603

Control Description

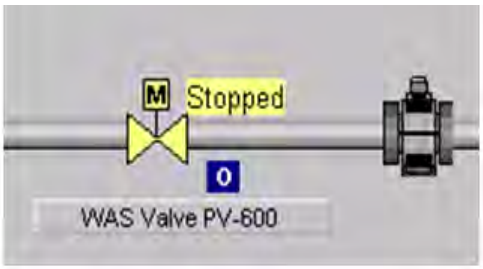
Was Valve

Once the RAS process has been started, the operator starts the WAS wasting process.

Hand Mode

Select Hand on the Hand-Off-Auto selector switch (located on the WAS valve) to operate the WAS valve locally. The operator uses the buttons located on the valve to open/close it.

Selecting the WAS Valve (PV-600) on the Solids Overview Screen



Remote Operator Mode

Select the Auto position on the Auto-Off-Hand selector switches located on the WAS valve to put the valve in the Remote mode. Select Program mode from the **WAS Valve_PV-600 Faceplate**.

Operator Mode (Manual)

Click on the **WAS Valve_PV-600** section of the **Solids Overview** screen. The system displays the **WAS Valve_PV-600** Faceplate.

WAS Valve_PV - 600 Faceplate

For manual Operator Control, select the **Operator** mode on the **WAS Valve PV-600** Faceplate. The Faceplate shown is used to control the valve's state. The operator open/closes the valve remotely from the **WAS Valve PV-600** Faceplate. The available Faceplate commands include:

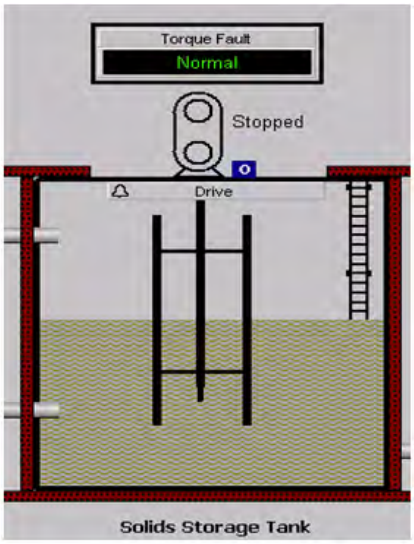
- Press the **Open** button to open the valve.
- Press the **Close** button to close the valve.
- Click the **Disable** button to remove the valve from service.
- Click the **Enable** button to place the unit back in service.

Solid Storage

The mechanism is protected from over-torque by overload switches set at the factory. The overload switches sense a buildup of torque as the mechanism revolves. A pre-set factory overload switch will trip to alarm the SCADA system as torque builds up. Further increasing torque will cause a second pre-set factory trip switch to trip and stop the mechanism from running. When the mechanism stops due to an overload or a power outage, the unit must be started manually.

The storage tank is equipped with a pressure-to-current (P/I) transmitter located near the bottom of the tank. The transmitter transmits a 420 mA signal to the Programmable Logic Controller (PLC). The signal is converted to indicate the tank levels on local indicators.

Solids Storage Tank on the Solids WTP Overview screen



Hand Mode

Select Hand on the Hand-Off-Auto selector switch (located at the MCC) to operate the SST locally. The operator uses the buttons located at the MCC to operate the tank.

Remote Operator Mode

Select the Auto position on the Auto-Off-Hand selector switches located at the MCC to put the SST drive in the Remote mode.

Operator Mode (Manual)

Click the SST Drive section of the **Solids Overview** screen. The system displays the Solids Tank 1 Drive Faceplate.

Solids Tank 1 Drive Faceplate

For manual Operator Control, select the **Operator** mode on the Solids Tank 1 Drive Faceplate. The Faceplate shown is used to control the Storage Tank Drive (STD). The operator starts and stops the STD remotely from the Solids Tank 1 Drive Faceplate. The available Faceplate commands include:

- Press the **Play** button to start the STD.
- Press the **Stop** button to stop the STD.
- Click the **Disable** button to remove the STD from service.
- Click the **Enable** button to place the unit back in service.

Solids Transfer Pump (STP)

The STP is controlled manually by plant operators. The pump discharges to a Belt Filter press, which removes water from the sludge.

Hand Mode

Select Hand on the Hand-Off-Auto selector switch (located at the MCC) to operate the pump locally. The operator uses the buttons located at the MCC to operate the pump.

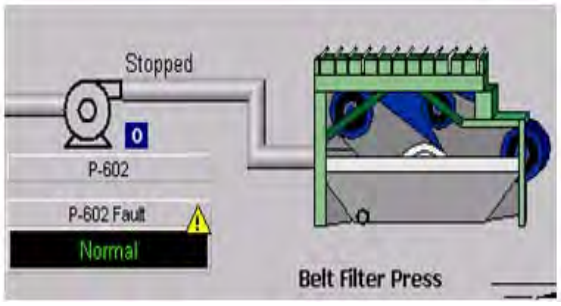
Remote Operator Mode

Select the Auto position on the Auto-Off-Hand selector switches located at the MCC to put the pump in the Remote mode.

Operator Mode (Manual)

Click the STP section of the **Solids Overview** screen.

Selecting the STP on the Solids Overview Screen



The system displays the **Tank Drive** Faceplate.

Solids Tank to Filter Press P-602 Faceplate

For manual Operator Control, select the Operator mode on the Solids Tank 1 to Filter Press P-602 Faceplate. The Faceplate shown is used to control the pump. The operator starts and stops the STD remotely from the Solids Tank 1 to Filter Press P-602 Faceplate. The available Faceplate commands include:

- Press the **Play** button to start the pump.
- Press the **Stop** button to stop the pump.
- Click the **Disable** button to remove the pump from service.
- Click the **Enable** button to place the unit back in service.

Alarms

The Supervisory Control and Data Acquisition (SCADA) system generates these two types of alarms.

- Process
- Equipment

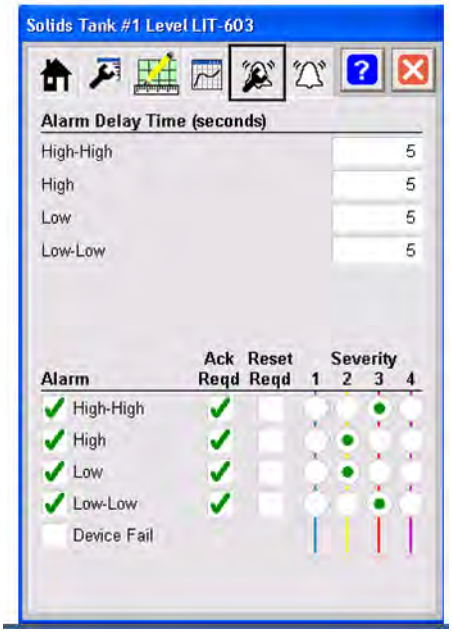
Process Alarms

There are the eight types of Process Alarms.

- Solids Storage Tank High LIT-603
- Solids Storage Tank Low LIT-603
- Solids Storage Tank High-High LIT-603
- Solids Storage Tank Low-Low LIT-603

- WAS Tank High
- WAS Tank Low
- WAS Tank High-High
- WAS Tank Low-Low

Process Alarms



Equipment Alarms

These are the two types of Equipment Alarms.

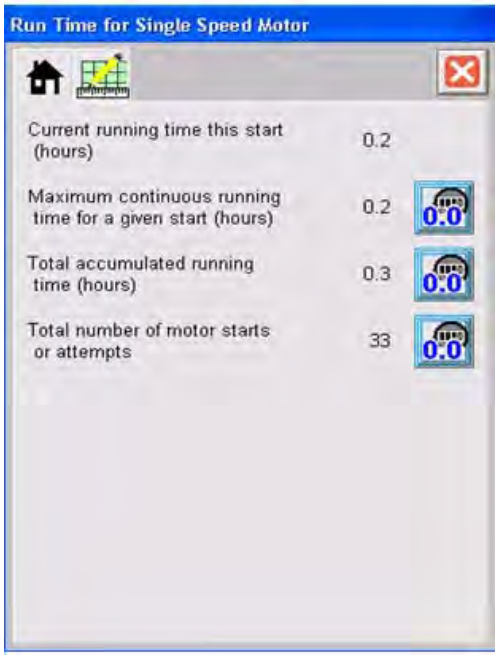
- **Start/Stop Faults** - If the Solids Storage Tank Mechanism or Sludge Transfer Pump is called to start and is not running after 5 seconds, the system generates a Start/Stop Fail alarm at the HMI.

Reporting

The SCADA system records:

- Process - The system will trend common signals and record them for future viewing, including:
  - WAS Flow Rate
  - WAS Holding Tank Level
  - SST Level
- Equipment Runtimes
  - Runtimes are recorded for the STP and STD mechanism by the SCADA system. Depending on the user's security level, the total runtime may be reset by clicking on the **Total Reset** button next to the appropriate pump.
  - SST Mechanism
  - STP

Single Speed Motor Run Time



Customization of the Solids Application

General customization notes are included in the Lift Station Application section (page 102) of this chapter. Refer to this section before customizing any application, including the Solids application. This section describes customization specific to the Solids application.

I/O Assignment

As in the Lift Station, I/O is mapped into this application. This is done in the following project locations:

- MainProgram - A01_DiscreteInput - as needed - this routine is provided as a template.
- MainProgram - A02_AnalogInput - as needed - this routine is provided as a template.
- MainProgram - A03_Outputs - as needed - this routine is provided as a template.
- MainProgram - A04_AnalogOuput - as needed - this routine is provided as a template.

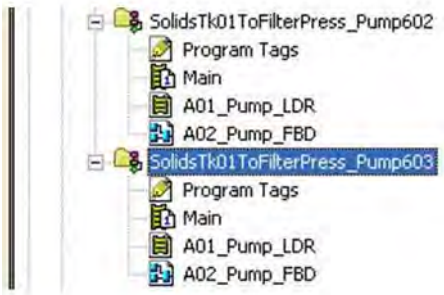
Additional Pumps/Motors (Single Speed Motor AOIs in a FBD Routine)

Although the following specific example illustrates how to add a Solids Transfer Pump, the procedure can be followed for many of the pumps/motors in the toolkit using the Single Speed Motor AOIs in a FBD routine. To add additional Solid Transfer pumps to the Solids application, add additional pump programs as required - these will be duplicates of SolidsTk01ToFilterPress_Pump602.

To add additional Solid Transfer pumps:

1. Copy and paste the existing SolidsTk01ToFilterPress_Pump602 and rename it (the name SolidsTk01ToFilterPress_Pump603 is used here).

Selecting Additional Pumps



2. Create new controller-scoped tags for the new pump.

Creating New Controller-Scoped Tags

P602_Fault	P_DIn
P602_Intlk	P_Intlk
P602_Motor	P_Motor
P602_Perm	P_Perm
P602_Reset	P_Reset
P602_ResInh	P_ResInh
P602_RunTime	P_RunTime
P603_Fault	P_DIn
P603_Intlk	P_Intlk
P603_Motor	P_Motor
P603_Perm	P_Perm
P603_Reset	P_Reset
P603_ResInh	P_ResInh
P603_RunTime	P_RunTime

3. In the program scoped tags for the new pump program, define the Alias for Device (and the other associated tags) as this new controller-scoped tag.

Defining Device Aliases

Equip_Fault	I_P603_Fault(C)	Local:3:I.Data.10(C)
Equip_Fault_IOFault	I_P603_Fault_IOFault(C)	Local:3:I.Fault.10(C)
Equip_GroupReset	PLC_Device_ResetPB(C)	PLC_Device_ResetPB(C)
Equip_InAuto	I_P603_InAuto(C)	Local:3:I.Data.11(C)
Equip_InAuto_IOFault	I_P603_InAuto_IOFault(C)	Local:3:I.Fault.11(C)
Equip_Intlk	P603_Intlk(C)	P603_Intlk(C)
Equip_IOFault		
Equip_Motor	P603_Motor(C)	P603_Motor(C)
Equip_Out_Run	O_P603_Out_Run(C)	Local:4:O.Data.4(C)
Equip_RunFdbk	I_P603_RunFdbk(C)	Local:3:I.Data.12(C)
Equip_RunFdbk_IOFault	I_P603_RunFdbk_IOFault(C)	Local:3:I.Fault.12(C)

4. Configure and alias all I/O for the new pump. The Configuring and Aliasing New Pump I/O table depicts the subset of the I/O required. Be sure to alias all the I/O to the new points for the additional pump. Be certain that all inputs and outputs are aliased to the correct location.

Configuring and Aliasing New Pump I/O

I_P603_Fault	Local:3:I.Data.10
I_P603_Fault_IOFault	Local:3:I.Fault.10
I_P603_InAuto	Local:3:I.Data.11
I_P603_InAuto_IOFault	Local:3:I.Fault.11
I_P603_RunFdbk	Local:3:I.Data.12
I_P603_RunFdbk_IOFault	Local:3:I.Fault.12
O_P603_Out_Run	Local:4:O.Data.4

5. Confirm that the new routines verify and contain no errors. The most commonly overlooked issues are reconciling all the tags used in the routine. The ladder and Function Block Diagrams themselves typically verify since they are duplicates of the original routines.

Routine Verification

```
Verifying program: SolidsTk01ToFilterPress_Pump603...
Verifying routine A01_Pump_LDR of Program SolidsTk01ToFilterPress_Pump603
Verifying routine A02_Pump_FBD of Program SolidsTk01ToFilterPress_Pump603
Verifying routine Main of Program SolidsTk01ToFilterPress_Pump603
Complete - 0 error(s), 0 warning(s)
```

Flushing System Application

Process Description

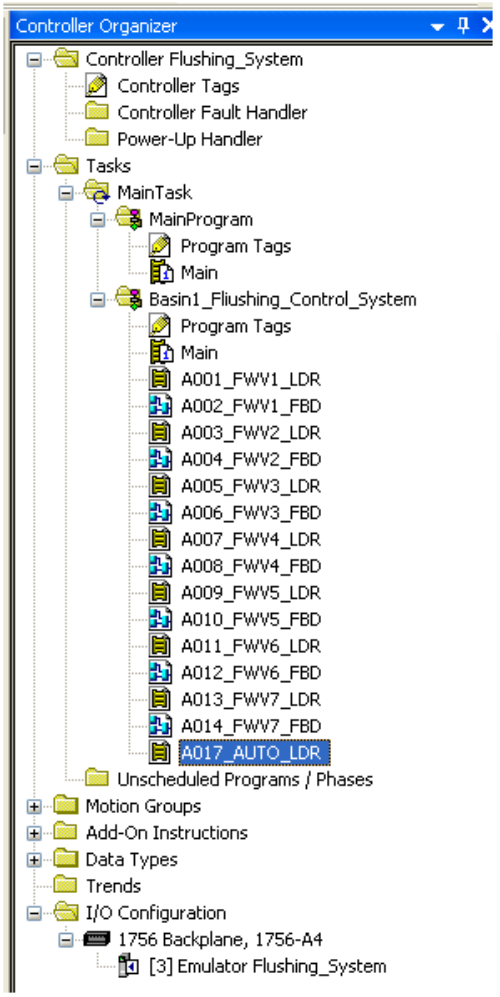
The Flushing System application contained on the WWWAT CD is a typical example of a flushing system of up to seven valves (solenoid or motor type valves) used to flush out a basin.

In the below example, seven solenoid valves are used. These valves operate in sequence based on an operator-selectable "Flushing Time" input from a pop-up window located on the HMI flushing system overview screen. The flush system can be started, paused, or reset from this HMI pop-up.

When the flushing sequence begins, the system opens flushing valve #1 (FV1) and keeps it open for the duration of the operator-selectable flush time. Should a flushing valve be out of service for any reason (in manual mode or shut down for service, for example) the program will skip that valve and go to the next available valve in the sequence.

Control Description

The controller organization for the Flushing System application is as follows:



Main Program

There is no logic in the routine for this example.

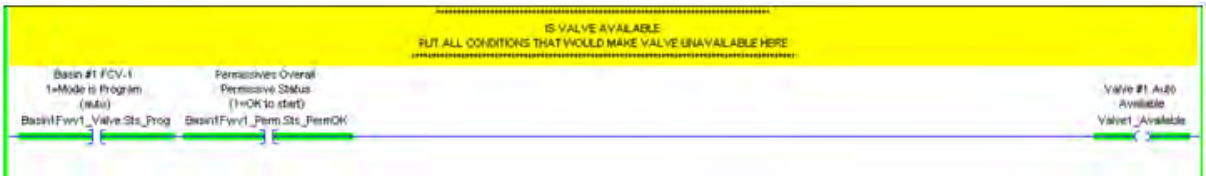
BASIN1_FLUSHING_CONTROL_SYSTEM_ PROGRAM

Main - This program contains the JSRs to all the routines in this program.

A001_FWV1_LDR - This routine contains all the logic that controls Flushing Water Valve1, called FV1. This routine is typical for all the flushing valves that can be in a program, for example, FV2, FV3...FV7. Here, FVx represents any program valve.

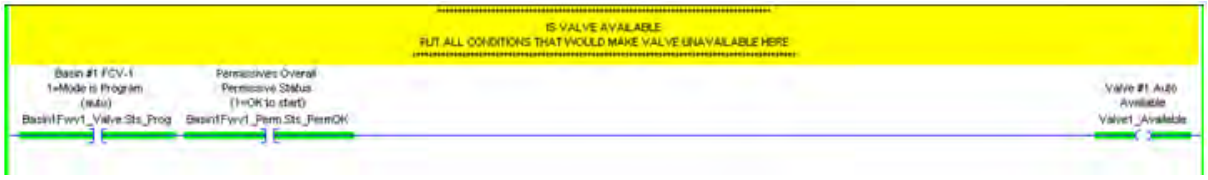
Rung 0

This rung contains all conditions that would make the valve "unavailable" for use.



Rung 1

This rung opens FVx when the "start basin flush" HMI PB is pressed. This rung is typical for all valves.

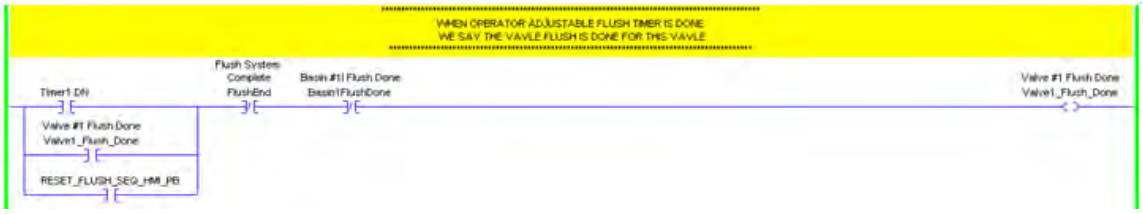


Rung 2 and 3

These rungs take the flush time entered from the HMI and place it in a timer specific to the applicable valve. If a basin flush is active, the flush sequence is not complete, and the valve is opened, the timer is started for FVx. These rungs are typical for all valves.

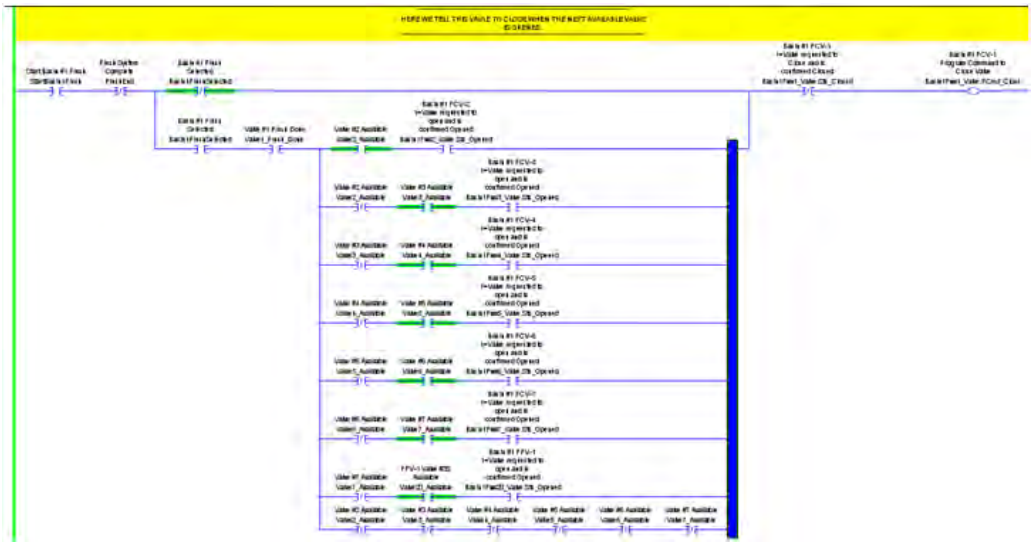
Rung 4

This rung indicates that the valve flush time has expired. Once expired, the next available valve is activated.



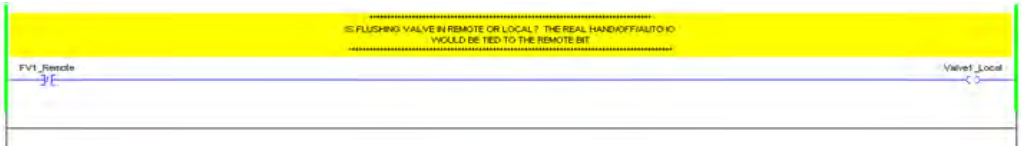
Rung 5

This rung causes the valve to close when the next valve in the sequence is open and available. To customize this rung for an additional valve, the valve's ladder and FBD routines are inserted and the next valve's tags are inserted in sequence in this rung. For a valve following FV7, for example, valve FV8 tags would be added to the last 2 rungs.



Rung 6

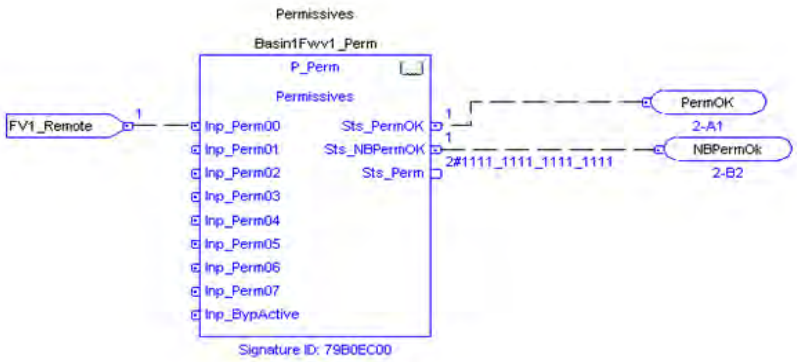
This rung indicates remote or local mode to the valve faceplate.



A001_FWV1_FBD - These two sheets contain the P_perm (permissives) and the P_valveSO add-on instructions for FV1. This routine is typical for all valves.

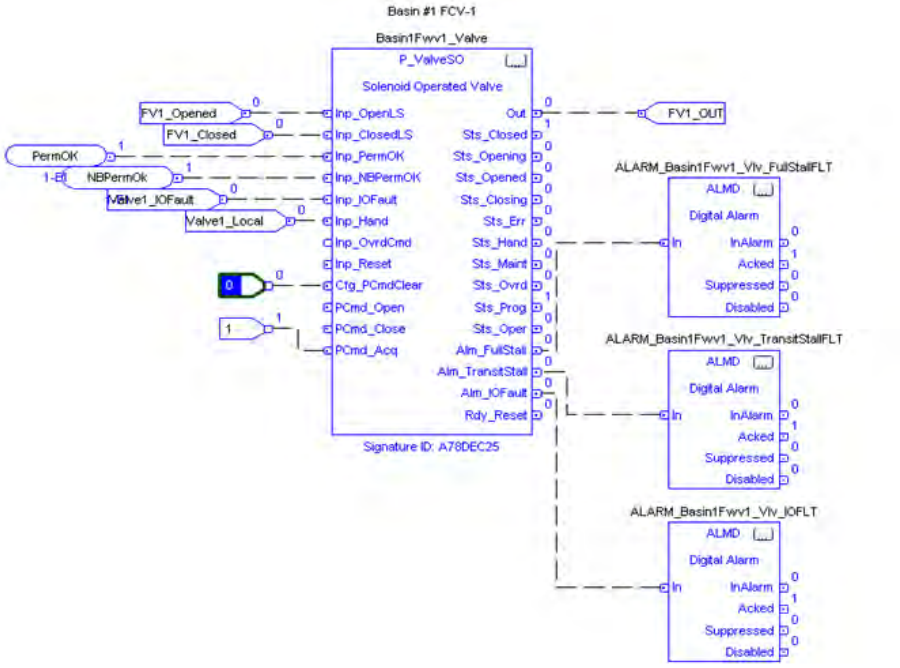
Sheet #1

All valve permissions are added here.



Sheet #2

This sheet contains the P_ValveSO add-on instruction for the valve. The real opened/closed limit switches are attached to the FV_Opened and FV_Closed tags, respectively. The real-world output attaches to the FV1_OUT tag.



IMPORTANT The routines for valves 2 through 7 are identical to the above routine for FV1. The only rung in each routine which has to be modified for an additional or a subtracted valve is Rung 5.

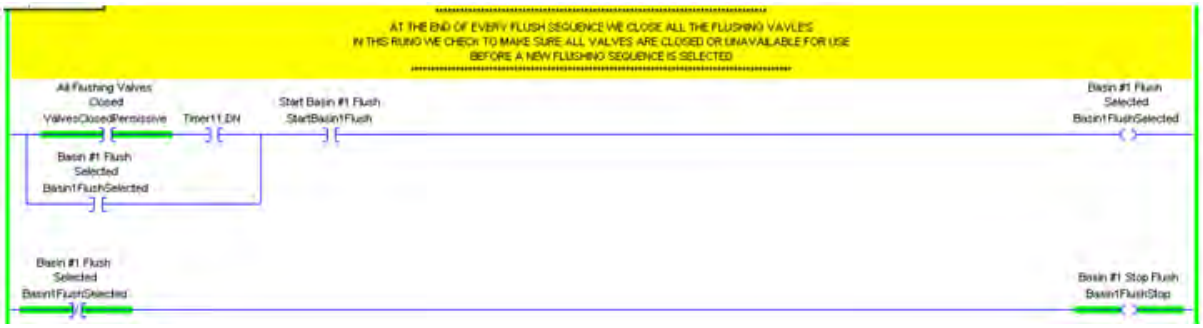
A017_AUTO_LDR - This routine contains the information which ties all the valves in your application together.

Rung 0

This rung examines the HMI start PB. When the button is pressed, the "StartBasin1Flush" bit is turned on. This bit is used throughout the application to indicate that a flush sequence has been started.

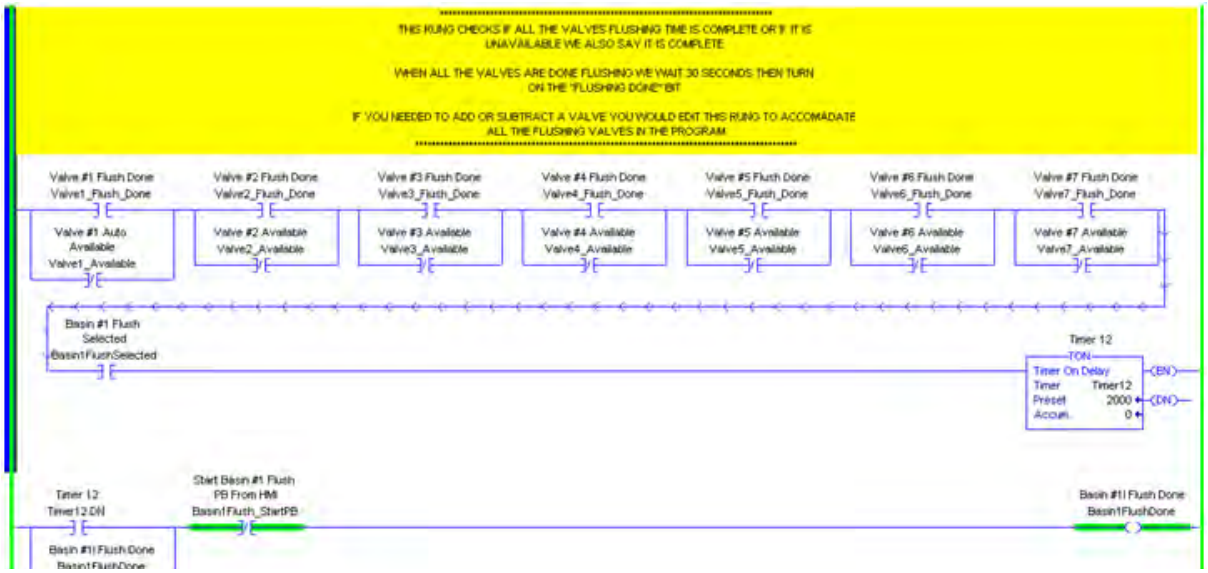
Rungs 1 and 2

These rungs ensure that a new sequence will not begin unless all valves are either closed or otherwise unavailable prior to the sequence start.


AT THE END OF EVERY FLUSH SEQUENCE WE CLOSE ALL THE FLUSHING VAVLES
IN THIS RUNG WE CHECK TO MAKE SURE ALL VALVES ARE CLOSED OR UNAVAILABLE FOR USE
BEFORE A NEW FLUSHING SEQUENCE IS SELECTED
All Flushing Valves Closed
ValvesClosedPermissive
Timer11.DN
Start Basin #1 Flush
StartBasin1Flush
Basin #1 Flush Selected
Basin1FlushSelected
Basin #1 Flush Selected
Basin1FlushSelected
Basin #1 Flush Selected
Basin1FlushSelected
Basin #1 Stop Flush
Basin1FlushStop

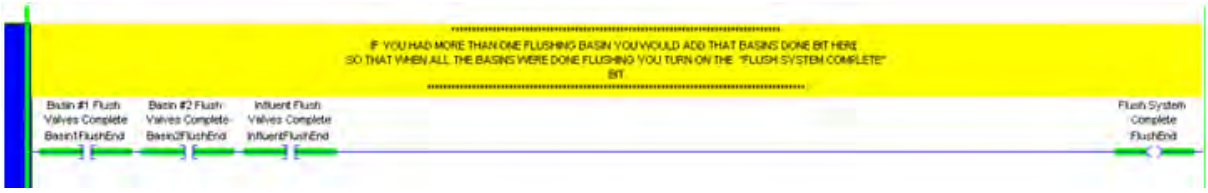
Rungs 3 and 4

These rungs ensure that all valves in the sequence have either completed their flushing or were unavailable at the time the sequence began. These lines of logic may also be modified to add or remove a valve from the sequence.



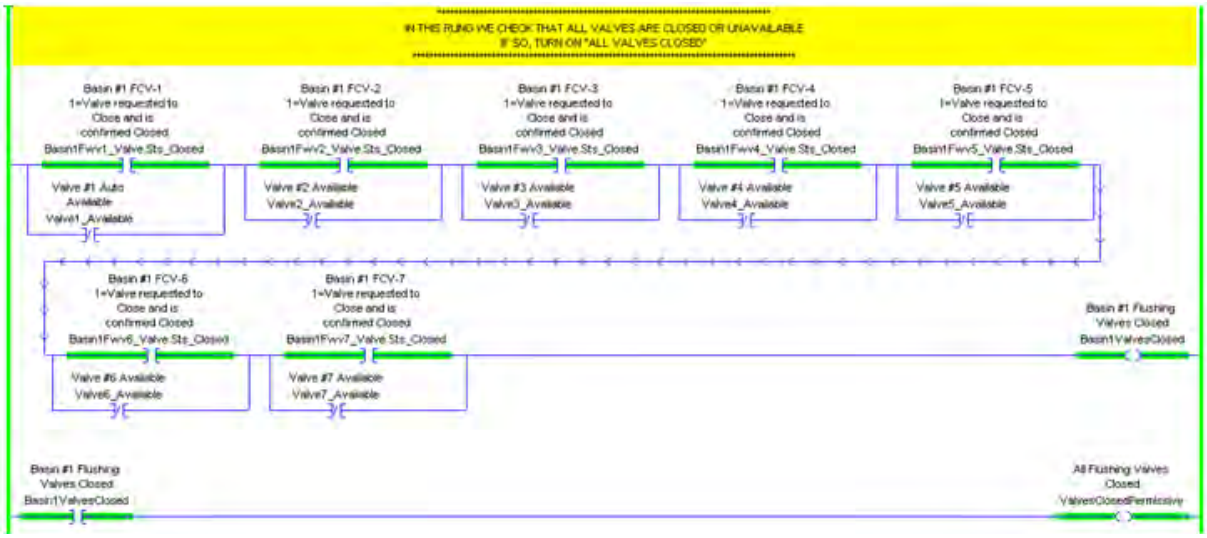
Rung 6

This rung tells the system that the entire flush sequence is complete. Additional flush sequences may also be added here.


IF YOU HAD MORE THAN ONE FLUSHING BASIN YOU WOULD ADD THAT BASINS DONE BIT HERE
SO THAT WHEN ALL THE BASINS WERE DONE FLUSHING YOU TURN ON THE "FLUSH SYSTEM COMPLETE"
BIT
Basin #1 Flush Valves Complete
Basin1FlushEnd
Basin #2 Flush Valves Complete
Basin2FlushEnd
Influent Flush Valves Complete
InfluentFlushEnd
Flush System Complete
FlushEnd

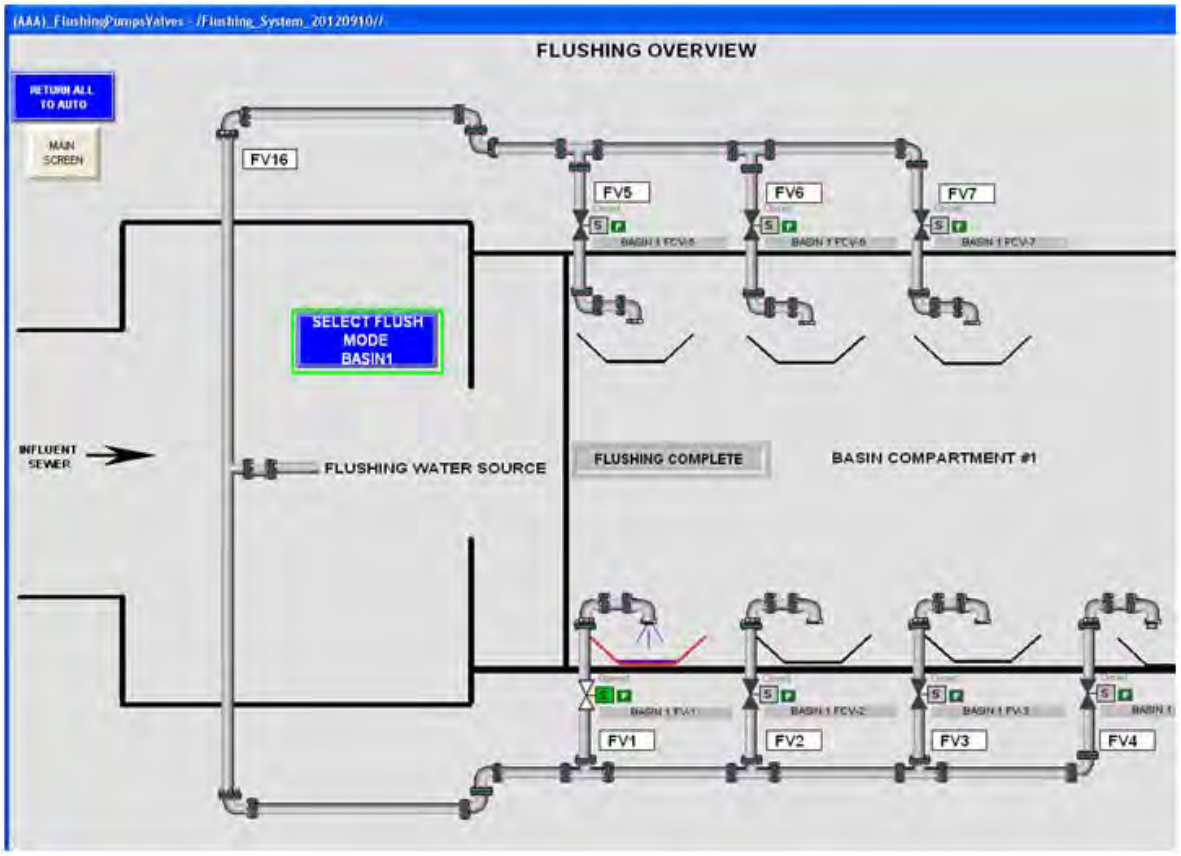
Rungs 7 and 8

These rungs verify that all valves are either closed or unavailable, then all valves are activated. This bit must be "on" for a sequence to be complete. These lines of logic may also be modified to add or remove a valve from the sequence.


IN THIS RUNG WE CHECK THAT ALL VALVES ARE CLOSED OR UNAVAILABLE
IF SO, TURN ON "ALL VALVES CLOSED"
Basin #1 FCV-1 1=Valve requested to Close and is confirmed Closed
Basin1Fwv1_Valve Sts_Closed
Valve #1 Auto Available
Valve1_Available
Basin #1 FCV-2 1=Valve requested to Close and is confirmed Closed
Basin1Fwv2_Valve Sts_Closed
Valve #2 Available
Valve2_Available
Basin #1 FCV-3 1=Valve requested to Close and is confirmed Closed
Basin1Fwv3_Valve Sts_Closed
Valve #3 Available
Valve3_Available
Basin #1 FCV-4 1=Valve requested to Close and is confirmed Closed
Basin1Fwv4_Valve Sts_Closed
Valve #4 Available
Valve4_Available
Basin #1 FCV-5 1=Valve requested to Close and is confirmed Closed
Basin1Fwv5_Valve Sts_Closed
Valve #5 Available
Valve5_Available
Basin #1 FCV-6 1=Valve requested to Close and is confirmed Closed
Basin1Fwv6_Valve Sts_Closed
Valve #6 Available
Valve6_Available
Basin #1 FCV-7 1=Valve requested to Close and is confirmed Closed
Basin1Fwv7_Valve Sts_Closed
Valve #7 Available
Valve7_Available
Basin #1 Flushing Valves Closed
Basin1ValvesClosed
Basin #1 Flushing Valves Closed
Basin1ValvesClosed
All Flushing Valves Closed
ValvesClosedPermissive

HMI Description

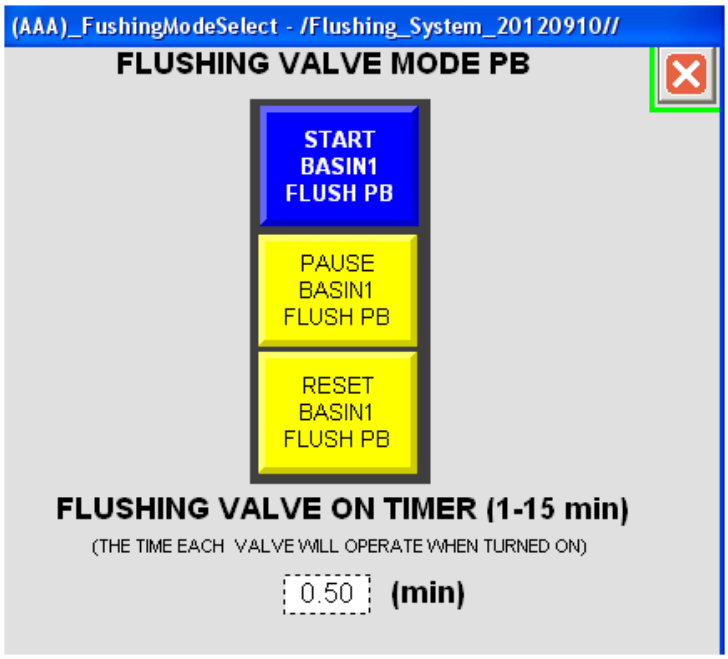
The following is a brief description of the HMI portion of this project.



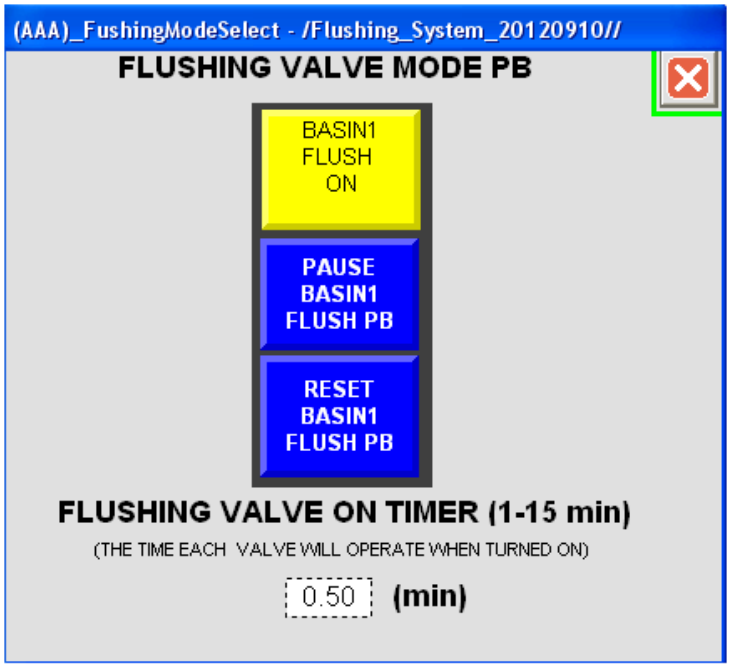
Select Flush Mode

To operate the system:

1. Enter a time in the "Flushing Valve On Timer" field.


(AAA)_FushingModeSelect - /Flushing_System_20120910//
FLUSHING VALVE MODE PB
START BASIN1 FLUSH PB
PAUSE BASIN1 FLUSH PB
RESET BASIN1 FLUSH PB
FLUSHING VALVE ON TIMER (1-15 min)
(THE TIME EACH VALVE WILL OPERATE WHEN TURNED ON)
0.50
(min)

2. Click the "Start Basin 1 Flush" button (see figure below). The button will turn yellow, indicating that "Basin1 Flush" is active.



3. To pause the sequence, click the "Pause Basin1 Flush PB" button. Click the button again to resume the sequence.

4. To start cycle over from the beginning, click "Reset Basin1 Flush PB."

"Return all to Auto" Button

When pressed this will automatically put all the devices not in auto already - in auto for you.

Simulation Mode

To operate system in simulation mode:

1. Open RSLogix Emulate Version 19.11.

2. Insert PLC in slot 3.

3. Open copy of Flushing System PLC Version 19.1, go to WHO Active, find emulator in slot 3 and download to it.

4. When finished downloading, put PLC in run mode.

5. Open Factory Talk View SE client and start the HMI application.

Chemical Feed System Application

Process Description

The chemical feed pump application is a typical example of a chemical feed system that assumes up to five variable frequency drives (VFDs) and transfers chemicals from up to two storage tanks into an influent tank that mixes the chemicals with the incoming influent liquid. Three chemical feed mixer units located in the influent tank ensure the chemical is mixed with the influent liquid. In this application a PIDE block is used to control the chemical feed flow rate into the influent tank and has manual and calculated set points.

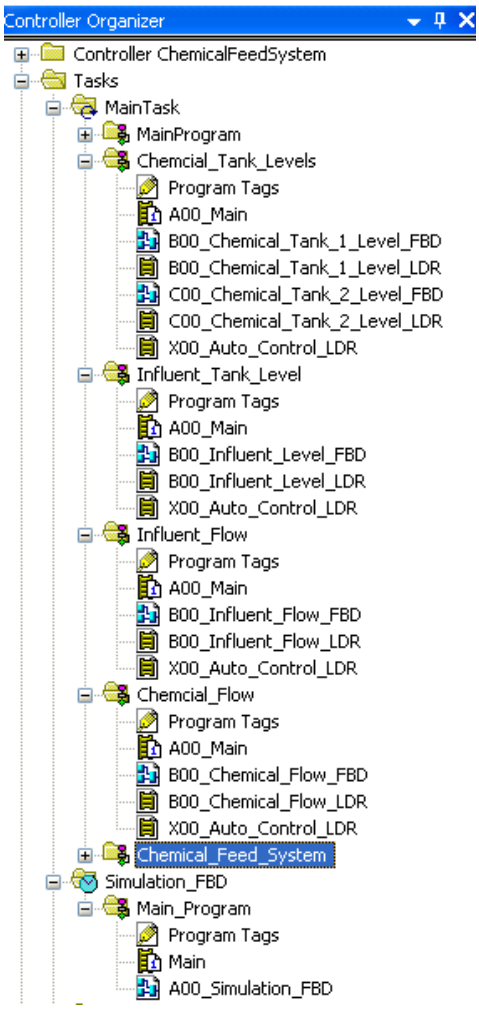
The five VFD pumps are controlled from the CV% (Control Variable). This application will demonstrate how to use the one CV% to control up to five VFDs (a very common real world situation). This is based on dividing the max CV (0-100%) by the number of VFD pumps. For this example 0-20% CV will

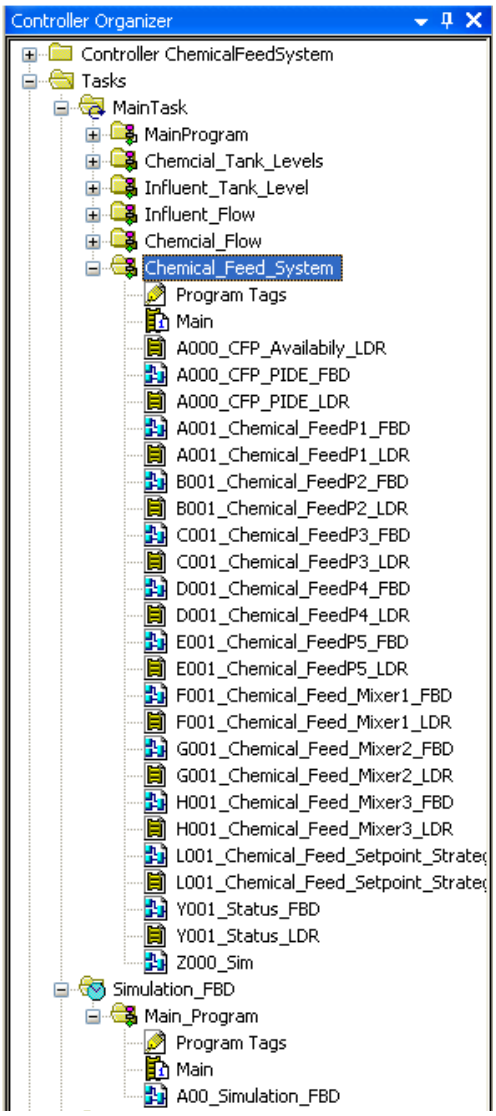
equal 0-100% speed for Pump 1. Pump 2 will use a CV of 21-40% to control 0-100% of its speed and so on. This is explained in more detail in the Chemical Feed System Program section.

Control Description

Refer to the Chemical Feed Application Controller Organization illustration to view the application's organization within the Controller.

Chemical Feed Application Controller Organization





The functionality for each program and routine is as follows:

Main Program

This program is used to display operator-assist messages and pop-ups on the HMI screen. It can also be used for all user routines that do not specifically affect direct operation of the system. Interlocks, heartbeats to other PLCs are examples of this.

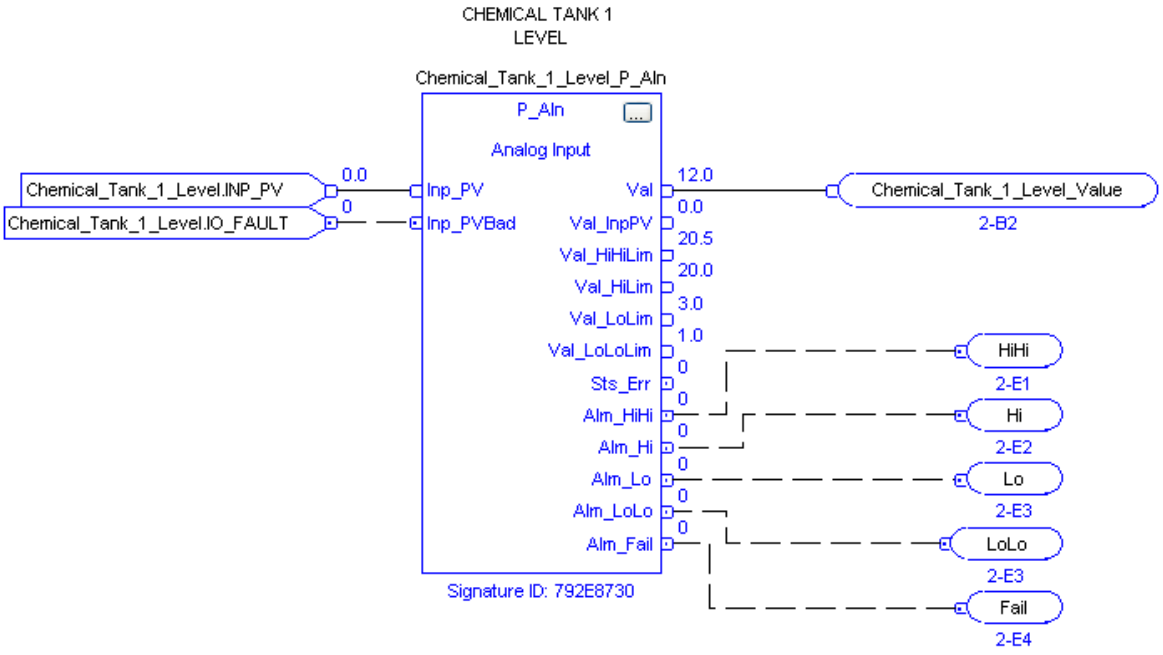
Chemical Tank Levels Program

Main – This program contains the JSRs to all the routines in this program.

The B00_Chemical_Tank_1_Level_FBD and C00_Chemical_Tank_2_Level_FBD routines contain the P_AIn AOI

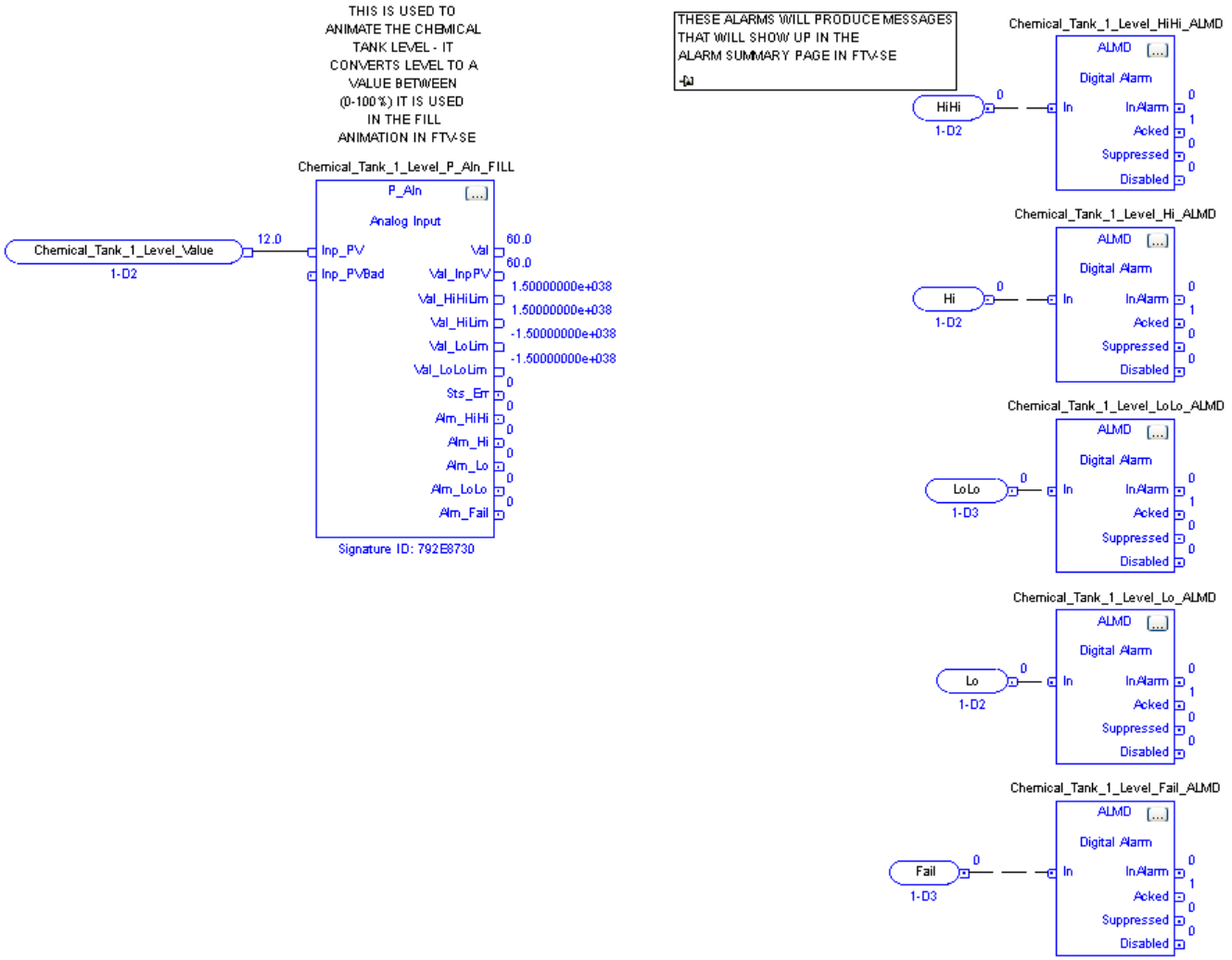
function block that calculates the levels for chemical tanks 1 and 2 on sheet #1.

Typical P_AIn instruction used for chemical tank level



Sheet #2 contains the ALMD function blocks for the high and low level faults of the P_AIn block. Using the ALMD blocks automatically inserts the fault message into the alarm banner if you choose to have an alarm banner in your HMI application and it contains a P_AIn block that converts the actual level of the tank to a percentage (0-100%) that is used to animate the chemical tank level on the HMI application. For a detailed explanation of how to set up your alarms please refer to the *FactoryTalk Alarms and Events System Configuration Guide*.

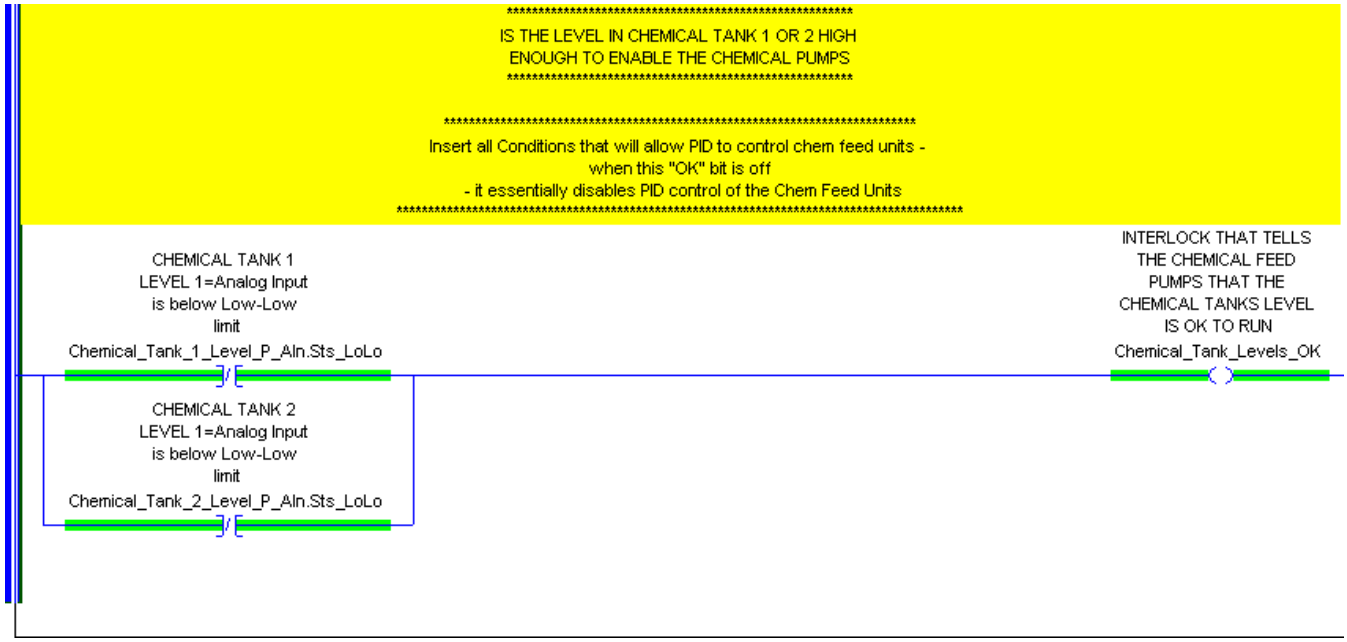
Typical P_AIn instruction used for the HMI tank level animation and the ALMD blocks used to display alarm messages on the alarm summary page (if used)



B00_Chemical_Tank_1_Level_LDRand C00_Chemical_Tank_2_Level_LDR – In this example program these routines are left blank.

X00_Auto_Control_LDR – This routine examines the LoLo alarm bit of the P_AIn instruction for chemical tanks 1 and 2. If the tanks are not at a Low-Low condition the "Chemical_Tank_Levels_OK" bit is set high and used as an interlock for the chemical feed pumps.

P_AIn alarm bits analyzed for the chemical tank level ok interlock


IS THE LEVEL IN CHEMICAL TANK 1 OR 2 HIGH
ENOUGH TO ENABLE THE CHEMICAL PUMPS
Insert all Conditions that will allow PID to control chem feed units -
when this "OK" bit is off
- it essentially disables PID control of the Chem Feed Units
CHEMICAL TANK 1
LEVEL 1=Analog Input
is below Low-Low
limit
Chemical_Tank_1_Level_P_AIn.Sts_LoLo
CHEMICAL TANK 2
LEVEL 1=Analog Input
is below Low-Low
limit
Chemical_Tank_2_Level_P_AIn.Sts_LoLo
INTERLOCK THAT TELLS
THE CHEMICAL FEED
PUMPS THAT THE
CHEMICAL TANKS LEVEL
IS OK TO RUN
Chemical_Tank_Levels_OK

Influent Tank Level Program

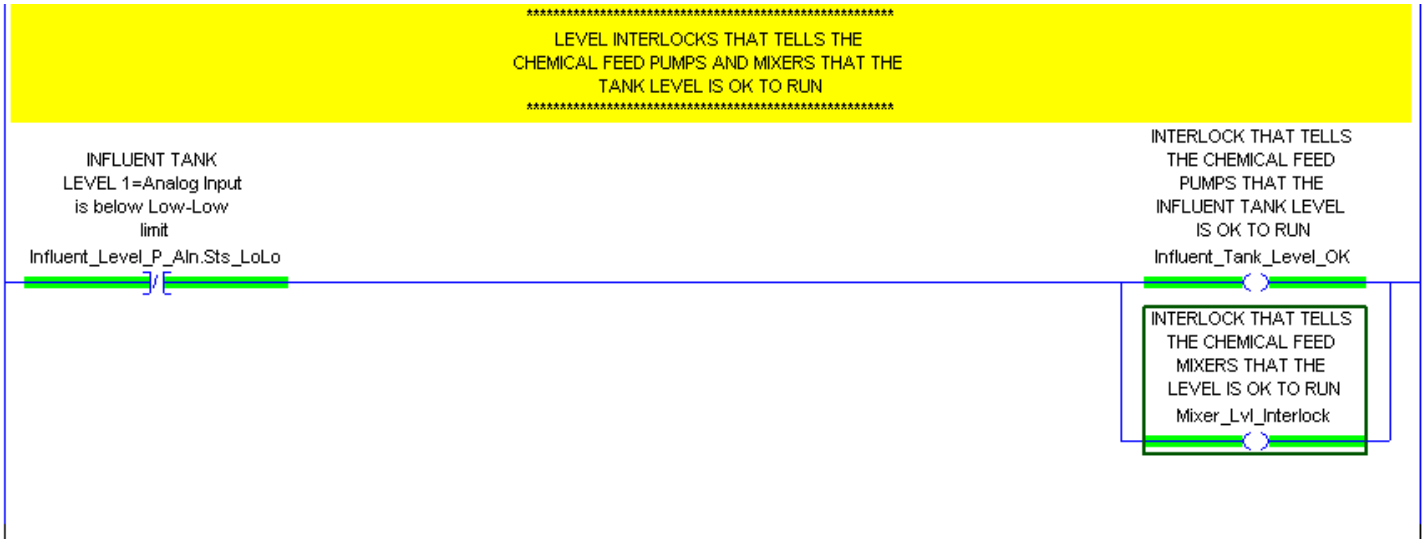
Main – This program contains the JSRs to all the routines in this program.

B00_Influent_Level_FBD – This routine contains the P_AIn AOI function block that calculates the influent tank level on sheet #1. Sheet #2 contains the ALMD function blocks for the high and low level faults of the P_AIn block and it contains a P_AIn block that converts the actual level of the tank to a percentage (0-100%) that is used to animate the influent tank level on the HMI application. For an example of how the function block diagram (FBD) is programmed see figures 3 and 4. For a detailed explanation of how to set up your alarms please refer to the *FactoryTalk Alarms and Events System Configuration Guide*.

B00_Influent_Level_LDR – In this example program this routine is left blank.

X00_Auto_Control_LDR – This routine examines the "LoLo" alarm bit of the P_AIn instruction and if the alarm bit is off the "Influent_Tank_Level_OK" and "Mixer_Lvl_Interlock" bits are set high and used as interlocks for the chemical feed pumps and chemical feed mixer interlocks.

P_AIn alarm bit analyzed and used by the chemical feed pumps and mixers as interlocks

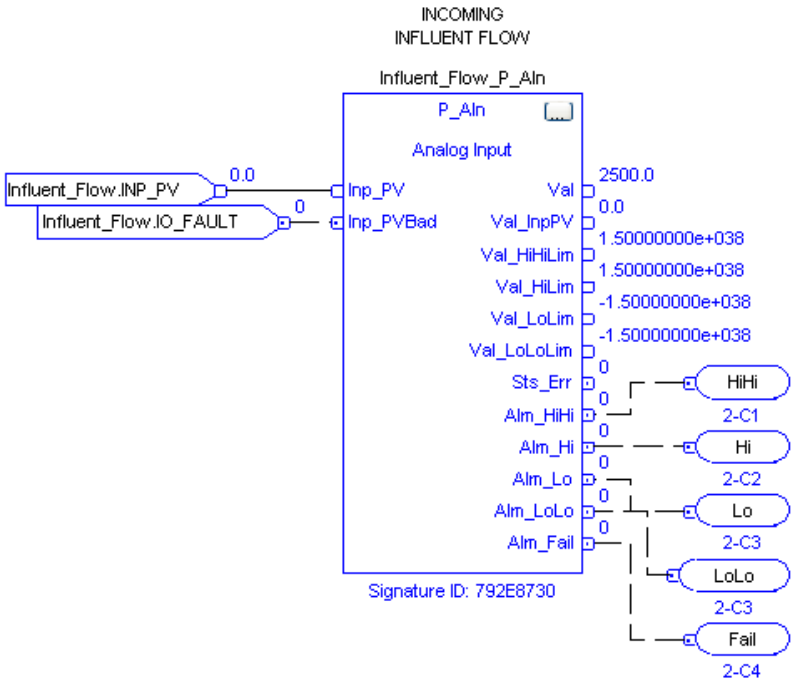


Influent Flow Program

Main – This program contains the JSRs to all the routines in this program.

B00_Influent_Flow_FBD – This routine contains the P_AIn AOI function block that calculates the influent flow on sheet #1. Sheet #2 contains the ALMD function blocks for the high and low flow faults of the P_AIn block. Again, the ALMD blocks are used if the user wants to populate the alarm summary page with alarm messages. For a detailed explanation of how to set up your alarms please refer to the *FactoryTalk Alarms and Events System Configuration Guide*.

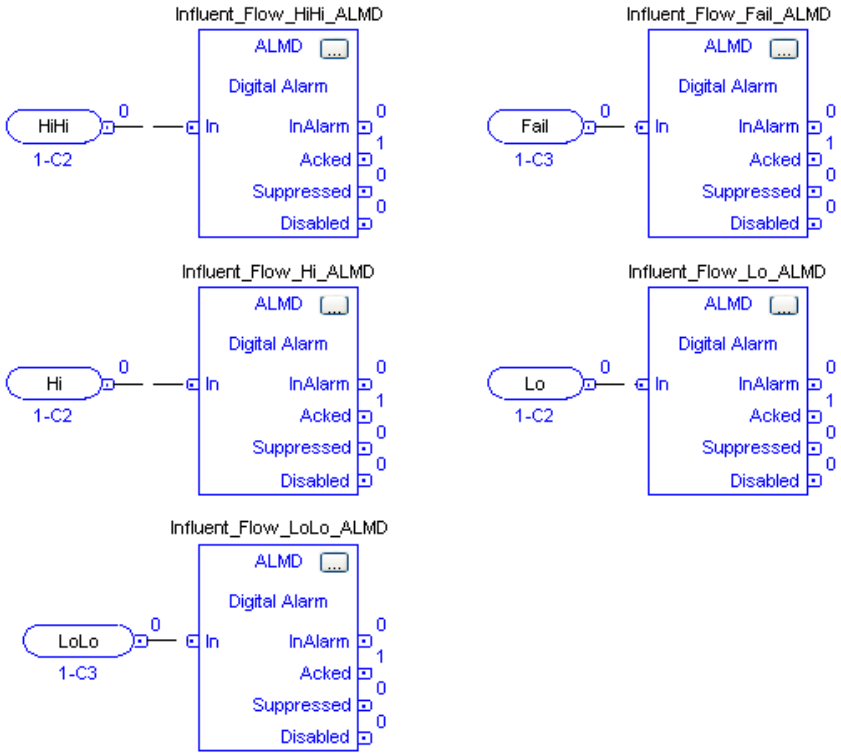
Typical P_AIn instruction used for Influent Flow



Sheet #2 contains the ALMD function blocks for the high and low flow faults of the P_AIn block. Again, the ALMD blocks are used if the user wants to populate the alarm summary page with alarm messages.For a detailed explanation of how to set up your alarms please refer to the *FactoryTalk Alarms and Events System Configuration Guide*.

THESE ALARMS WILL PRODUCE MESSAGES
THAT WILL SHOW UP IN THE
ALARM SUMMARY PAGE IN FTV-SE

ALMD blocks used to display alarm messages on the alarm summary page (if used)



B00_Influent_Flow_LDR – In this example program this routine is left blank.

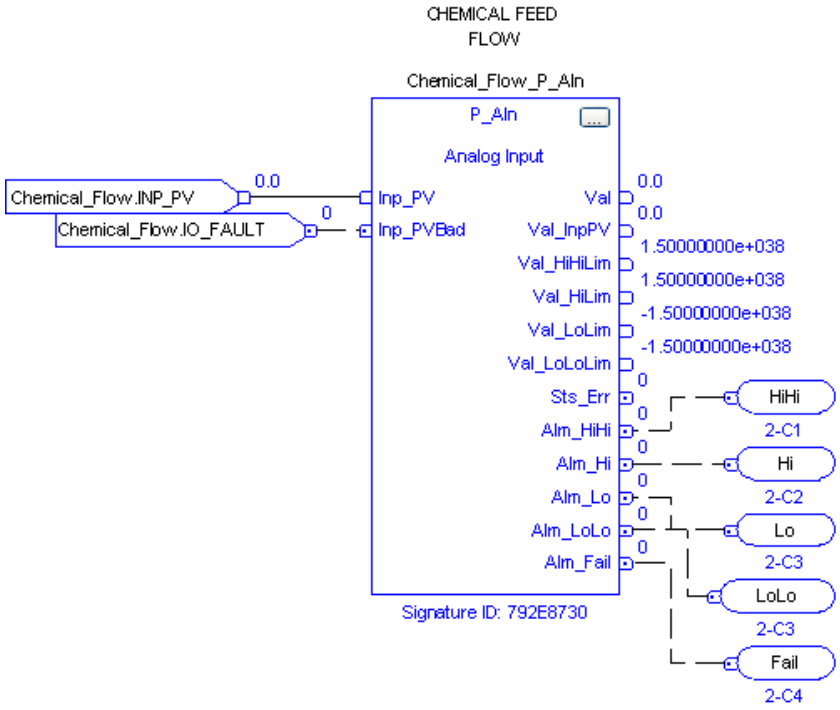
X00_Auto_Control_LDR – The routine is left blank in this application but should the programmer need to add any logic for this program it would be placed in this routine.

Chemical Flow Program

Main – This program contains the JSRs to all the routines in this program.

B00_Chemical_Flow_FBD – P_AIn FBD used in calculating the chemical flow out of the chemical feed pumps. Note that in this application the "Chemical_Flow_P_AIn.Val" tag is used as our PV (process variable) in the "ChemicalFeedP_PIDE" routine PIDE.

Typical P_AIn instruction used for Chemical Flow



B00_Chemical_Flow_LDR – In this example program this routine is left blank.

X00_Auto_Control_LDR – The routine is left blank in this application but should the programmer need to add any logic for this program it would be placed in this routine.

Chemical Feed System Program

This is the main part of the chemical feed system as this program contains the five chemical feed pump and mixer logic.

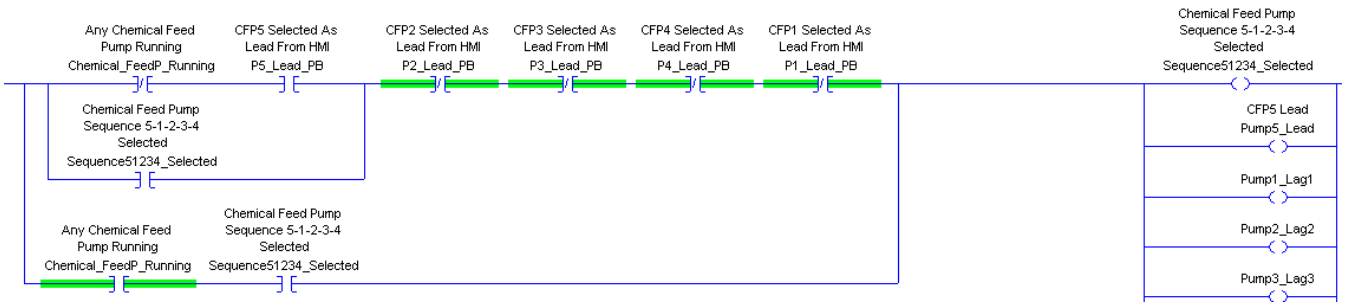
Main – This program contains the JSRs to all the routines in this program.

A000_CFP_Availabily_LDR – The rungs in this program enable the operator to pick a pump sequence and it also checks the availability of the pump (can it be used in our sequence) – if it is not ready it is skipped during automatic cycle.

Customization

Should a pump need to be added the programmer can copy rung 4, paste it and change the tags to reflect new pump sequence.

Typical logic to select pump sequence


Any Chemical Feed Pump Running Chemical_FeedP_Running
CFP5 Selected As Lead From HMI P5_Lead_PB
CFP2 Selected As Lead From HMI P2_Lead_PB
CFP3 Selected As Lead From HMI P3_Lead_PB
CFP4 Selected As Lead From HMI P4_Lead_PB
CFP1 Selected As Lead From HMI P1_Lead_PB
Chemical Feed Pump Sequence 5-1-2-3-4 Selected Sequence51234_Selected
Chemical Feed Pump Sequence 5-1-2-3-4 Selected Sequence51234_Selected
Any Chemical Feed Pump Running Chemical_FeedP_Running
Chemical Feed Pump Sequence 5-1-2-3-4 Selected Sequence51234_Selected
Chemical Feed Pump Sequence 5-1-2-3-4 Selected Sequence51234_Selected
CFP5 Lead Pump5_Lead
Pump1_Lag1
Pump2_Lag2
Pump3_Lag3

The next step would be to add another pump to the "not available" section of logic.

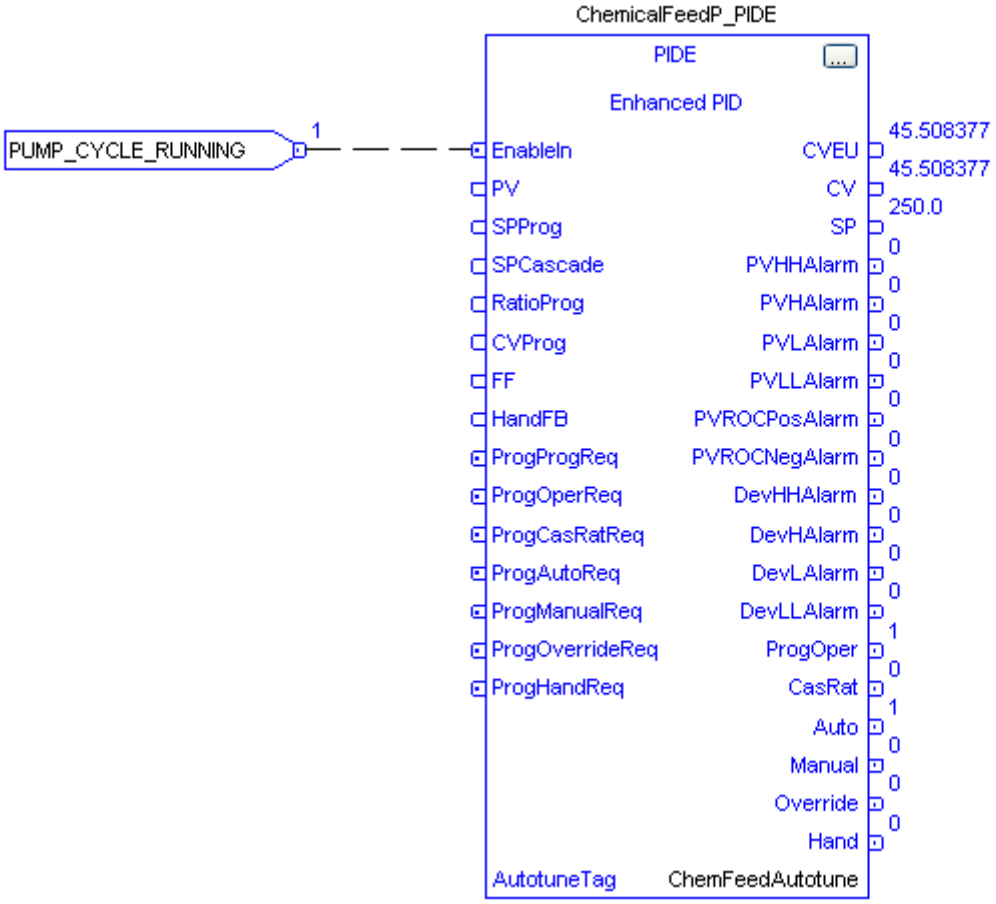
Typical logic to indicate pump is not available

Finally, the following rung would need to be duplicated and changed to the new pump number. The purpose of this rung of logic is to indicate when a pump is at max speed. The max speed can be changed as explained in the "A001_Chemical_FeedP1_LDR" routine. There are some cases when the application or pump characteristics call for not waiting until the pump gets to 100% of is speed before the following pump is started. In this example when the pump reaches 90% of its top speed the next pump in sequence is started.

Typical logic to indicate pump at max speed

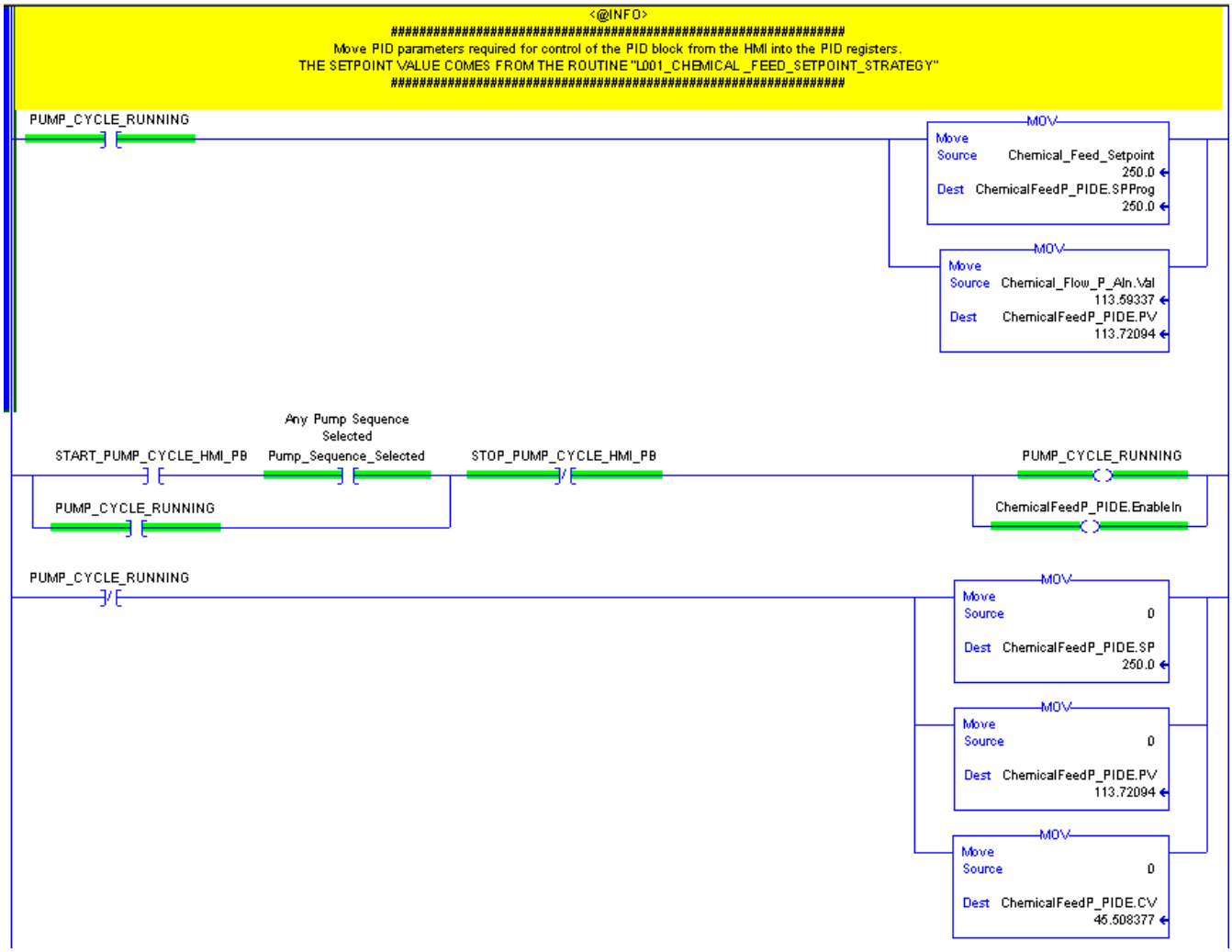
A000_CFP_PIDE_FBD – This routine contains the PIDE function block; PIDE is only available in function block format.

PIDE function block that controls how many pumps are needed to achieve the GPM set point



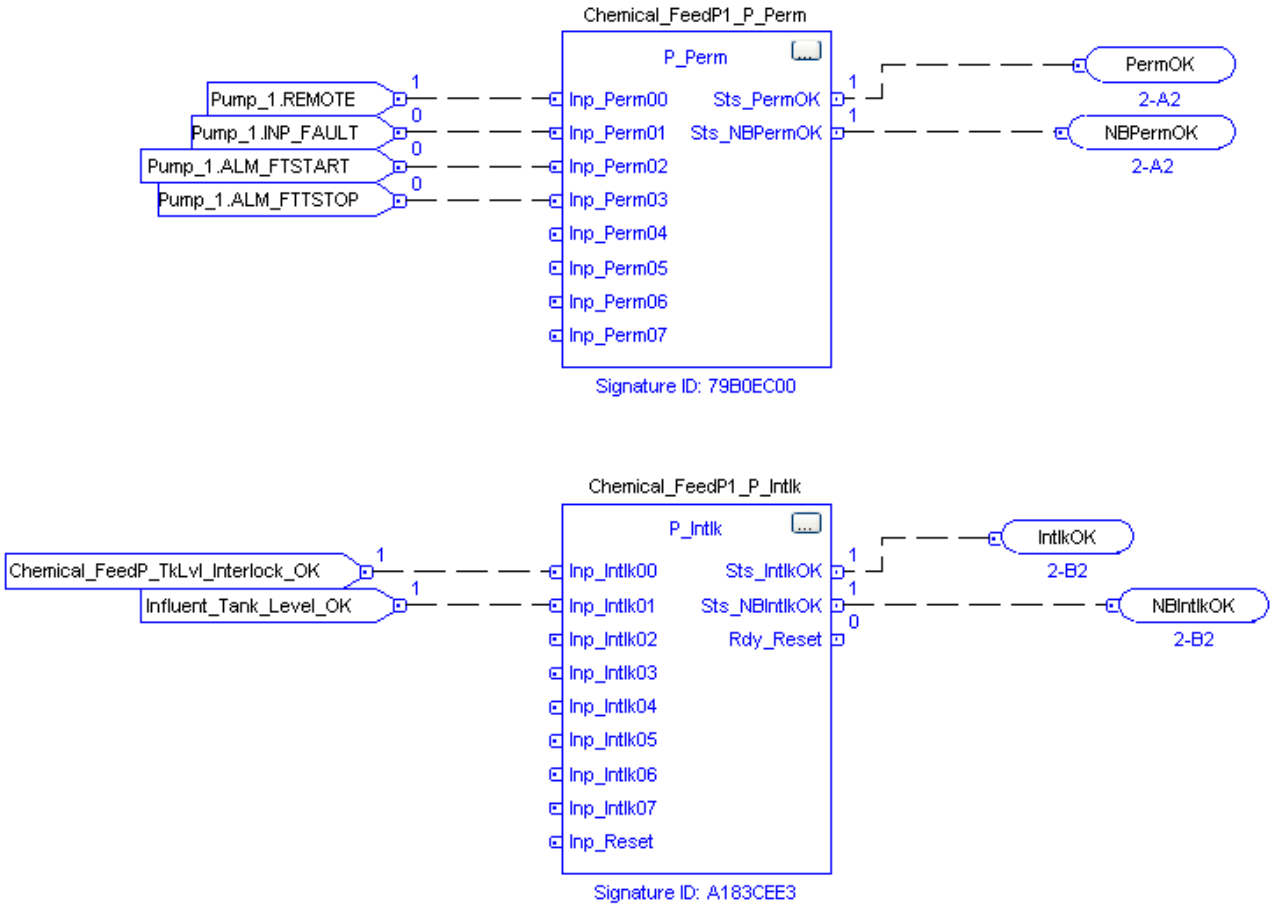
A000_CFP_PIDE_LDR – In this routine the Chemical Feed Flow set point is copied from the HMI input and placed in the PIDE set point. Also the PV (process variable) is copied into the PIDE PV. The last part of this routine contains a small example of starting and stopping the automatic cycle of this system. The purpose is to stop the PIDE from executing and "zeroing" out the CV%, current set point and PV. This enables the operator to be able to stop the system quickly and start it again with a different set point. It is a simple method to be able to start from a clean slate.

Set point, process variable and simple start/stop cycle logic



A001_Chemical_FeedP1_FBD –This routine contains the permissive, interlocks, VSD and alarm blocks for chemical feed Pump 1.

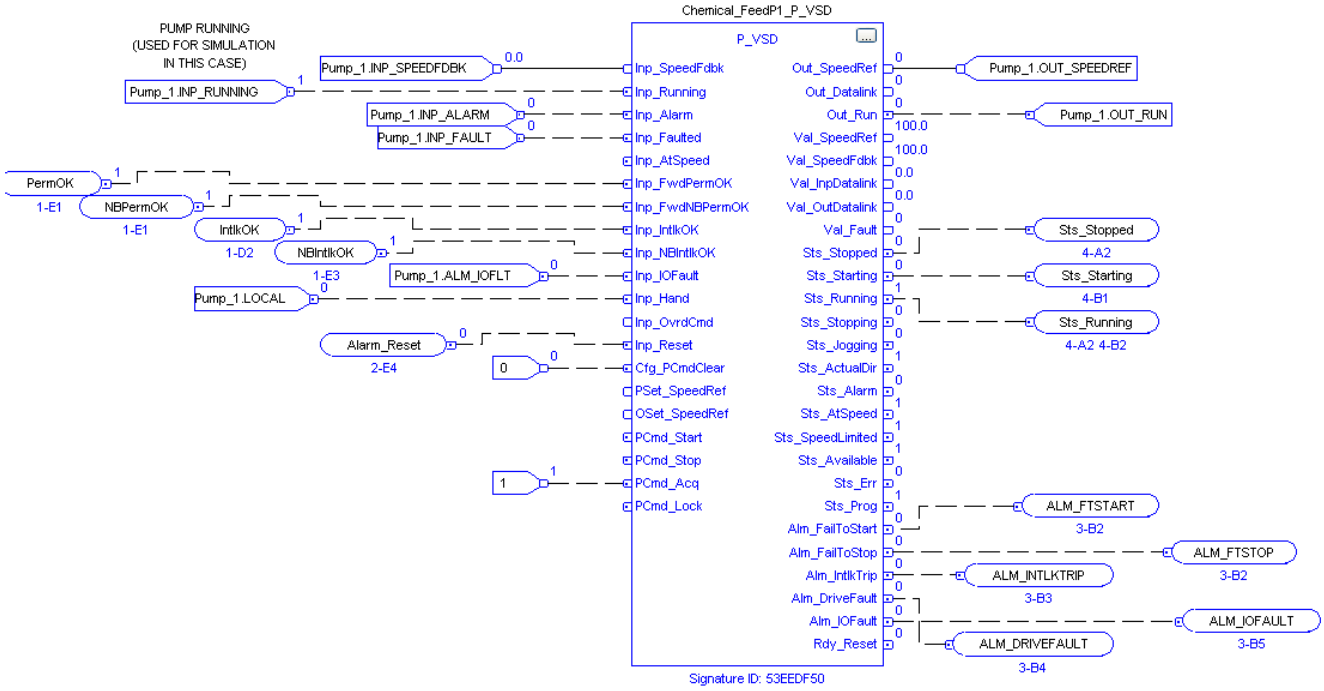
Typical permissive and interlock function blocks for Pump 1



Customization

To add a pump the programmer would copy the above FBD routine, paste it into a new routine and then change the tag names. Notice the "Pump_1" tag is a UDT that just has to be copied and pasted with a new tag name. Then it can be used as desired in the program and routine.

Typical VSD block for Pump 1

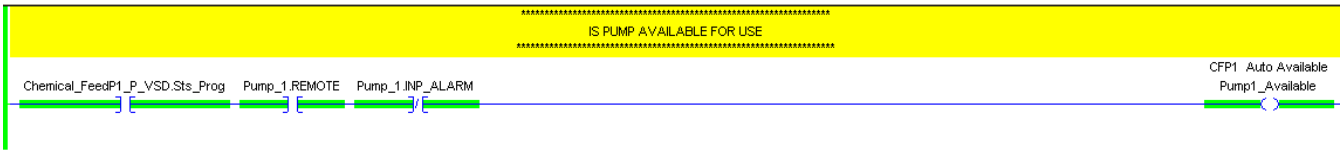


A001_Chemical_FeedP1_LDR – The following routine contains most of the logic that controls Pump1. It will be examined and explained rung by rung.

RUNG0

The following rung is where the programmer would put all the conditions that would make Pump1 "not available."

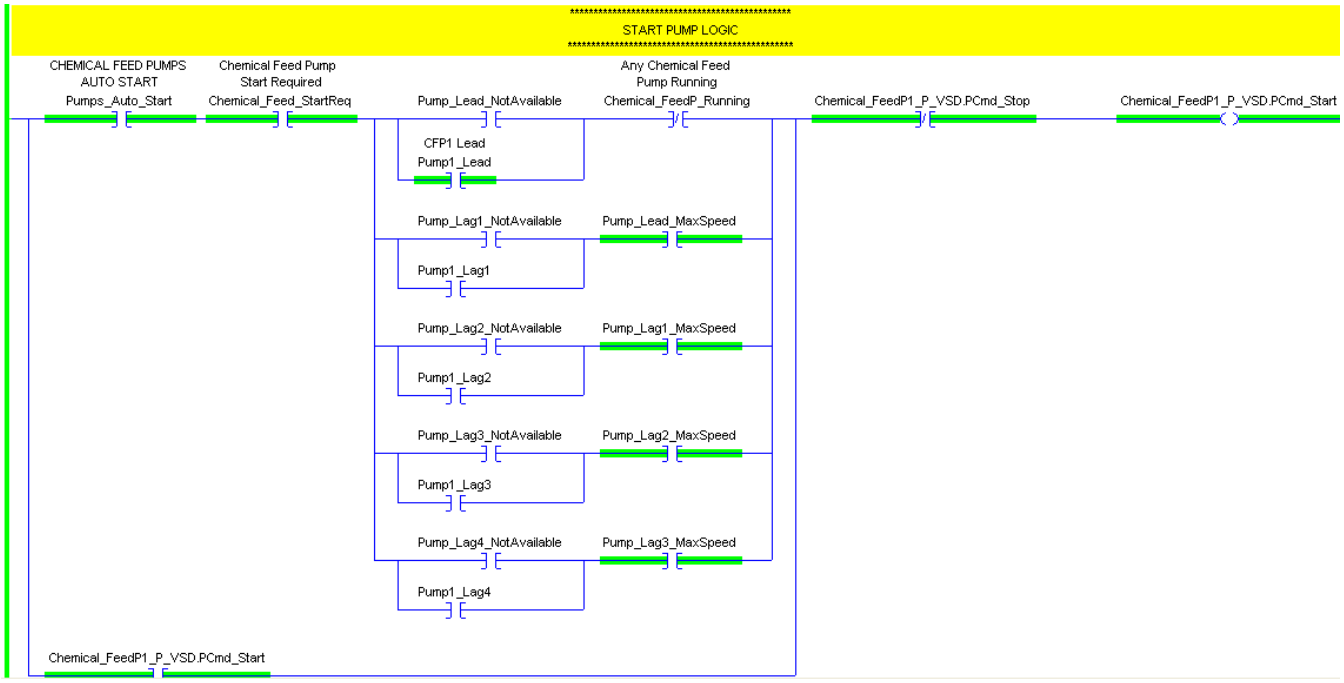
Pump available logic



RUNG 1

This rung contains the start pump logic:

Start pump logic

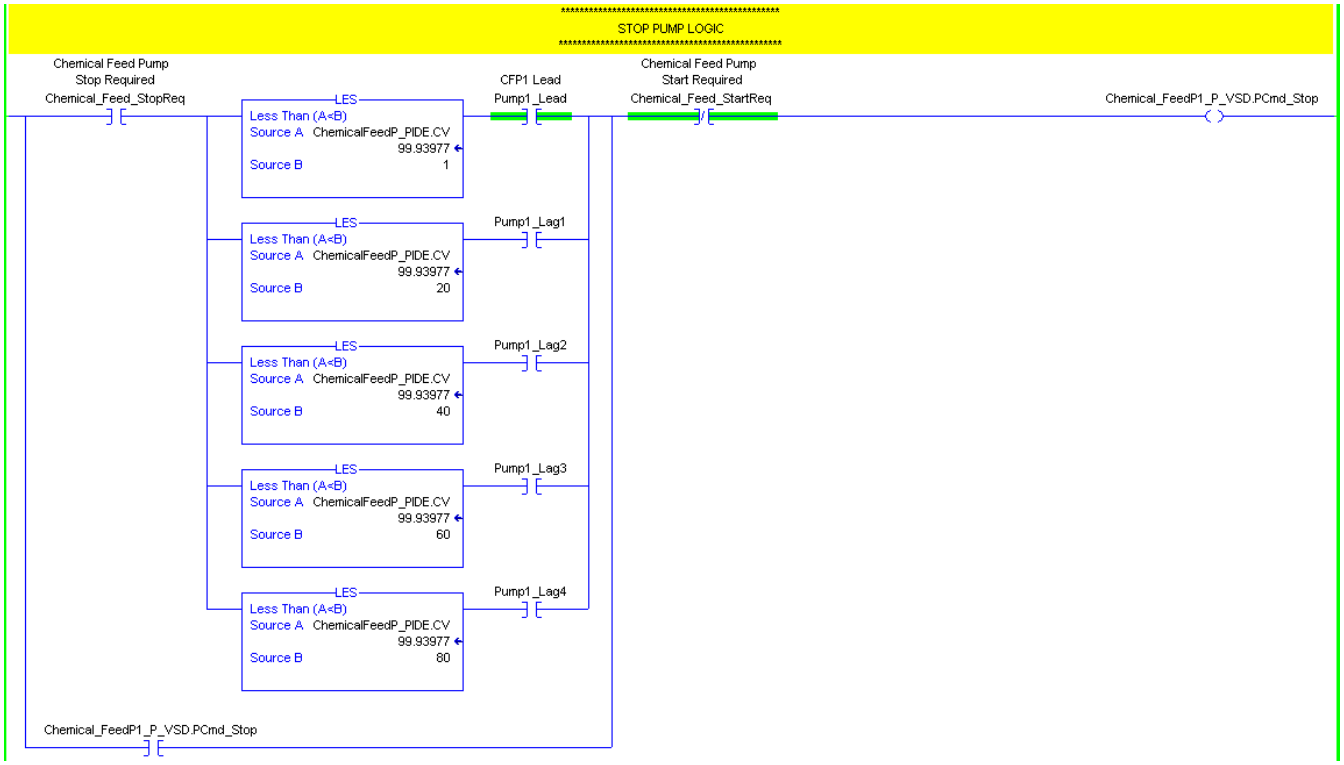


If the chemical tank and basin levels are "OK", we are calling for the pump to start and depending on what pump this is in the pump sequence we tell the pump to start. Notice we do not start the pump unless the pump ahead of it in the sequence is at max speed.

RUNG 2

Conditions to stop the pump: Since the CV is broken down into 20% increments (100% divided by 5) as the CV decreases the corresponding pump will stop.

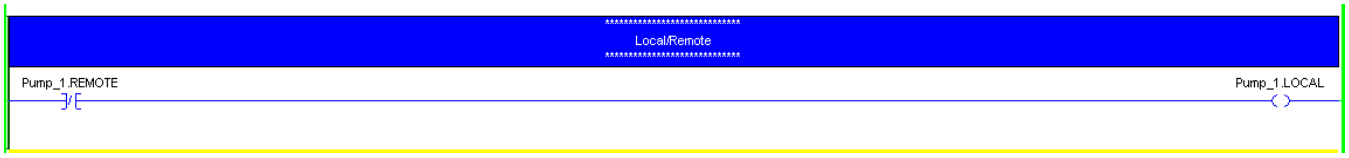
Stop pump logic



RUNG 3

Is pump in local or remote?

Local or Remote



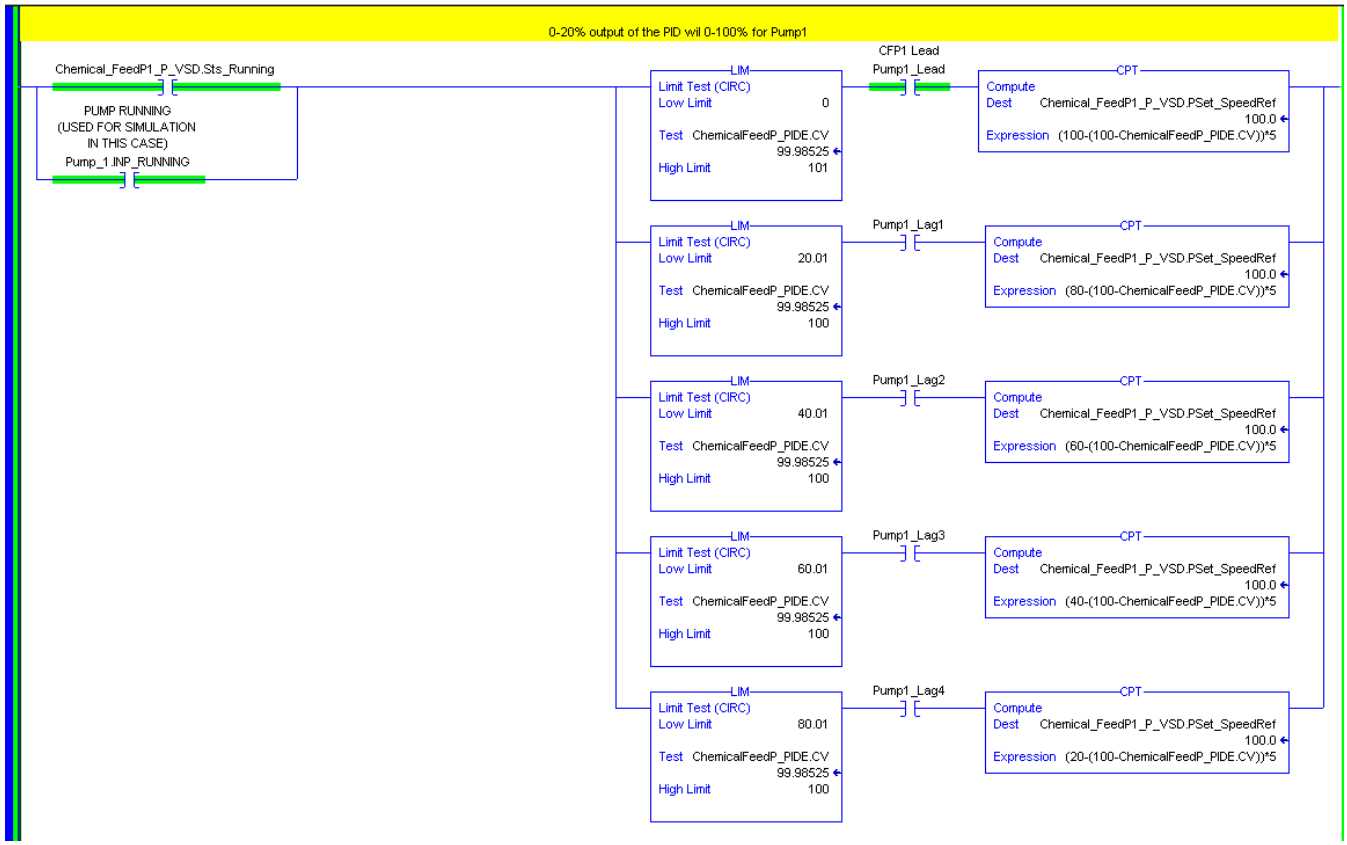
RUNG 4

In this rung we examine the CV% and the pump sequence number, then we take the computed value of the speed and put it into the "Pset_SpeedRef" tag of the pump.

Customization

To add/delete a pump you would take the max CV (100%) and divide it by the number of pumps this value would then be split evenly between the low limit of the LIM blocks, then a new expression would be put into the CPT block to reflect the new number of pumps.

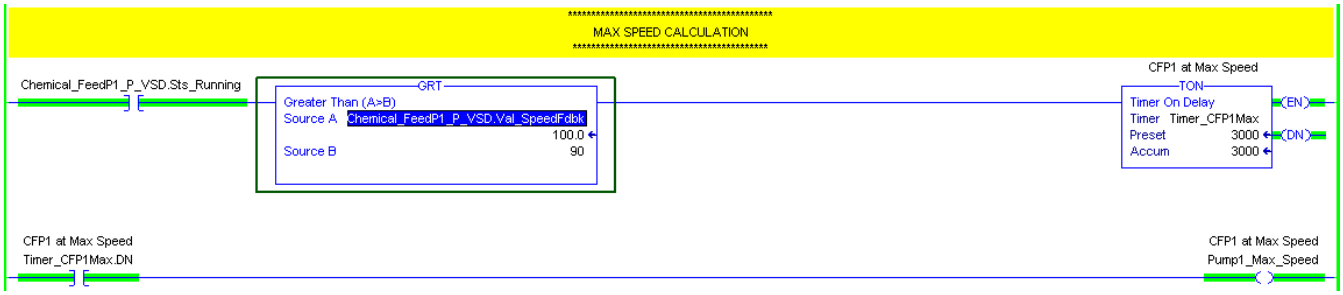
Pump speed calculation



RUNG 5 and 6

Max speed calculation – the speed at which, when the pump reaches it, the next pump in the sequence is started. In this case at a value of 90% the next pump in line will start.

Max speed calculation



Chemical Feed Mixers

These routines contain the P_Motor routines for the chemical mixers. If the "Influent Level" and a chemical feed pump are on, then the mixers are turned on.

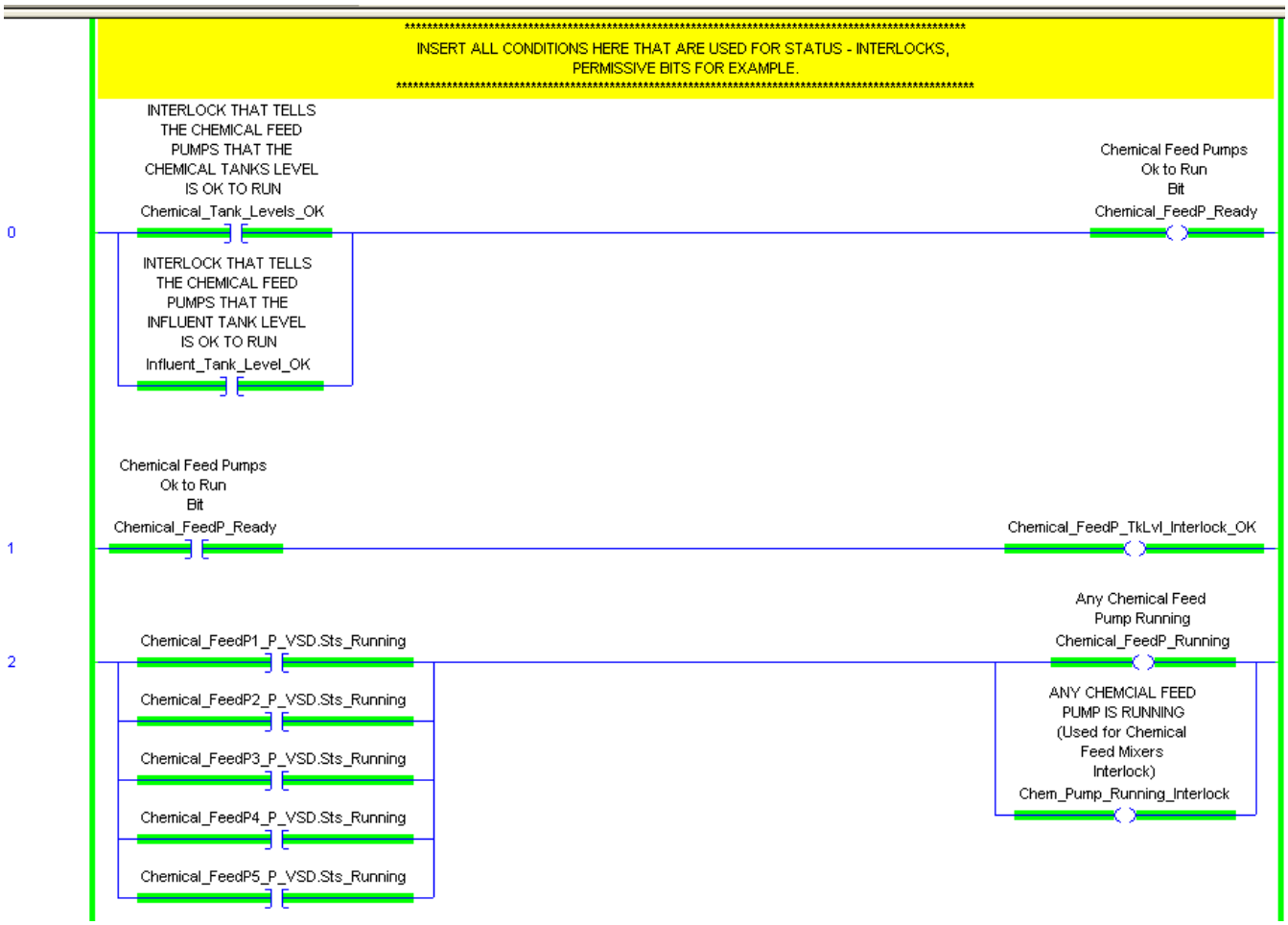
L001_Chemical_Feed_Setpoint_Strategy_LDR& FBD

This routine will contain the set point strategies of your system. In our case it contains an operator manually set point and the FBD routine contains a simple calculated set point.

Y001_Status_LDR& FBD

This routine contains all the user pertinent Status bits used for the programming of the Chemical Feed system. "All pumps running," "level status," and "pump sequence selected" are examples of Status bits.

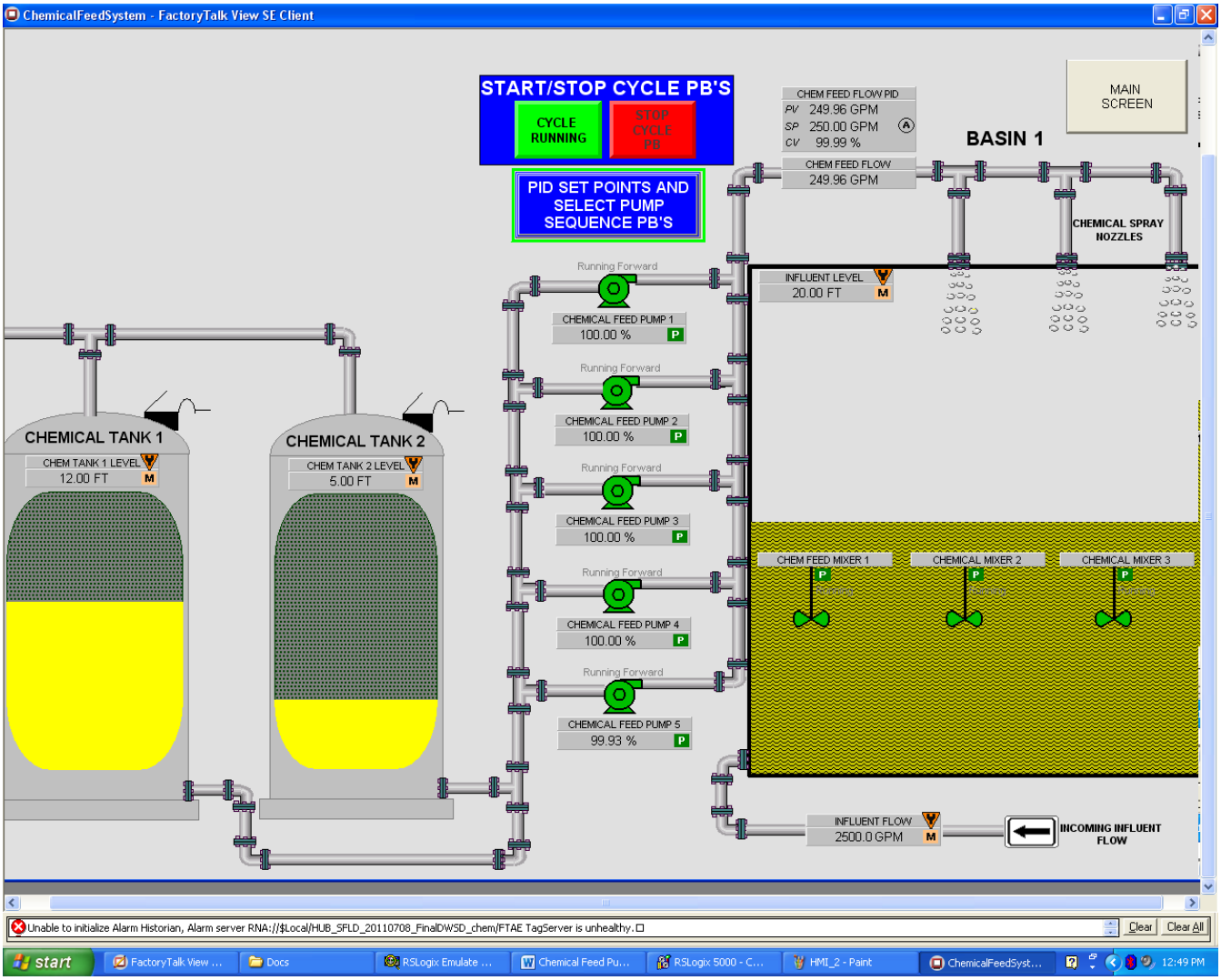
Status bits


INSERT ALL CONDITIONS HERE THAT ARE USED FOR STATUS - INTERLOCKS,
PERMISSIVE BITS FOR EXAMPLE.
INTERLOCK THAT TELLS THE CHEMICAL FEED PUMPS THAT THE CHEMICAL TANKS LEVEL IS OK TO RUN
Chemical_Tank_Levels_OK
INTERLOCK THAT TELLS THE CHEMICAL FEED PUMPS THAT THE INFLUENT TANK LEVEL IS OK TO RUN
Influent_Tank_Level_OK
Chemical Feed Pumps Ok to Run Bit
Chemical_FeedP_Ready
0
Chemical Feed Pumps Ok to Run Bit
Chemical_FeedP_Ready
Chemical_FeedP_TkLvl_Interlock_OK
1
Chemical_FeedP1_P_VSD.Sts_Running
Chemical_FeedP2_P_VSD.Sts_Running
Chemical_FeedP3_P_VSD.Sts_Running
Chemical_FeedP4_P_VSD.Sts_Running
Chemical_FeedP5_P_VSD.Sts_Running
Any Chemical Feed Pump Running
Chemical_FeedP_Running
ANY CHEMCIAL FEED PUMP IS RUNNING (Used for Chemical Feed Mixers Interlock)
Chem_Pump_Running_Interlock
2

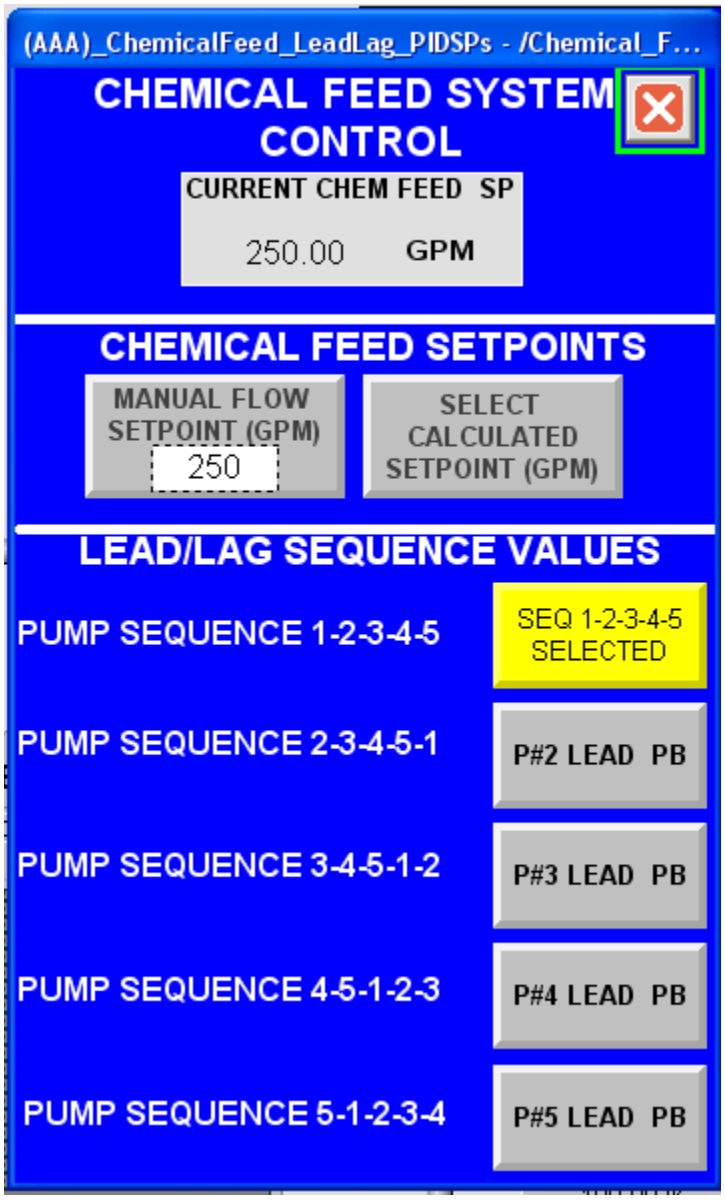
HMI Description

The following is a brief description of the HMI portion of this project.

HMI Overview screen



Chemical Feed set point and pump sequence selection



To operate system perform the following tasks:

1. In above pop-up choose "Manual Flow Set Point" and enter a flow value or select "Calculated Set Point." When "Select Calculated Set Point" is chosen you must insert a value in the "Influent Flow" faceplate (see fig 24) since the calculated set point value is derived from "influent flow."

2. Select a pump sequence.

3. Press the **Start Cycle** button.

Simulation Mode

To operate the system in simulation mode perform the following:

1. Open RSLogix Emulate Version 19.11. Insert PLC in slot 3.
2. Open a copy of Chemical Feed System PLC Version 19.1, go to WHO Active, find the emulator in slot 3 and download to it.
3. When you are finished downloading, put PLC in run mode.
4. Open the FactoryTalk View SE client and start the HMI application.

Water Treatment Plant Applications

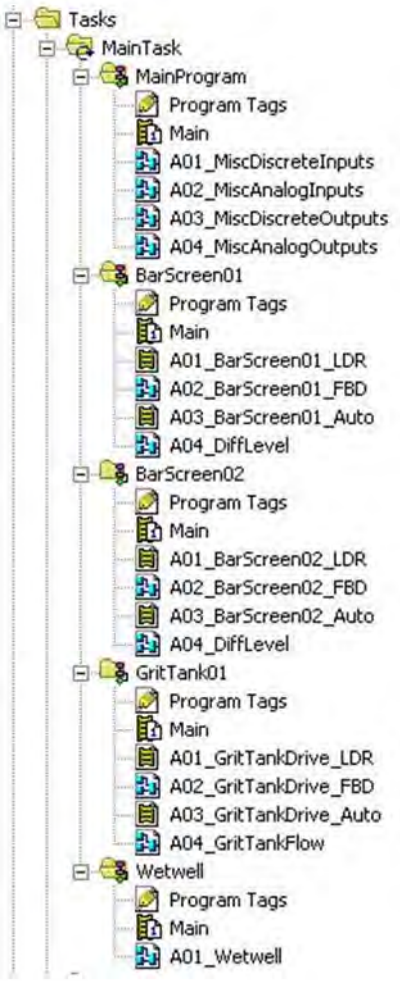
The Water Treatment Plant (WTP) documentation package contains the following applications:

- Raw Water Intake Pump Station System
- Separation Station System
- High Service Pump Station System

Raw Water Intake Application

The Raw Water Intake application is provided on the WWWAT CD. Refer to the Raw Water Intake System Application Controller Organization illustration to view the application's organization within the Controller.

Raw Water Intake System Application Controller Organization



This task should reside in a Controller in the main facility of the plant where the Raw Water Intake application is present and it is not intended to be the only application in the Controller. A ControlLogix processor is specified for this application for that specific reason. It is assumed the processor will be running other systems of the plant.

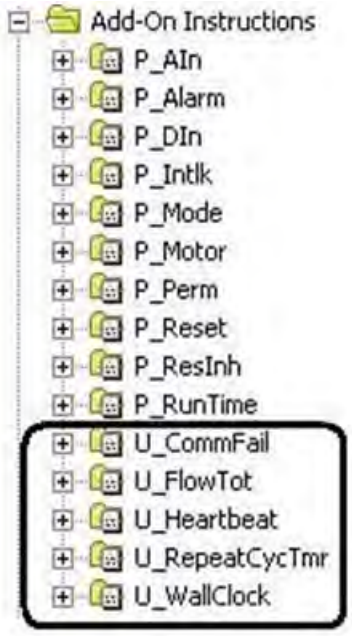
The organization of this application is similar to the other applications in this toolkit. Specifically, the functionality for each program and routine is:

- Main Program handles general Raw Water Intake application and functionality, including:
  - Main routine calls the other routines in this program and includes a Wall Clock AOI that calculates the day of the week.It also includes a Pump Inputs simulation bit that you can use when testing the application.
  - A01_MiscDiscreteInput includes a template to map inputs that are relevant throughout the Raw Water Intake system. This routine is provided as a Function Block Diagram.
  - A02_MiscAnalogInput includes a template to map analog inputs that are relevant throughout the Raw Water Intake system. This routine is provided as a Function Block Diagram.
  - A03_MiscOutputs includes a template to map outputs that are relevant throughout the Raw Water Intake system. This routine is provided as a Function Block Diagram.
- BarScreen01 controls the motor, manages cycle times, and Flow Channel Differential levels for the Bar Screen 1 system, including:
  - Main routine calls the other routines in this program.
  - A01_BarScreen01_LDR contains the code to monitor and control the Bar Screen 01 Motor and Reset Alarms, Interlocks, and Faults associated with the motor. This routine is provided as a Ladder Diagram.
  - A02_BarScreen01_FBD contains the Single Speed Motor, Permissives and Interlock AOIs that monitor and control the Bar Screen 01 motor. This routine is provided as a Function Block Diagram.
  - A03_BarScreen01_Auto contains the Cycle Timer (including the U_RepeatCycTmr AOI) and High Differential Alarm code. This routine is provided as a Ladder Diagram.
  - A04_DiffLevel contains the Analog Input AOI that monitors the preliminary treatment flow channel No 1's differential pressure level. This routine is provided as a Function Block Diagram.
- BarScreen02 Controls the motor and manages cycle times and flow channel differential levels for the Bar Screen 2 system as described for BarScreen01.
- GritTank01 Controls the motor and manages cycle times for the GritTank01 system, including:
  - Main routine calls the other routines in this program.
  - A01_GritTankDrive_LDR contains the code to monitor and control the Bar Screen 01 Reset Alarms, Interlocks, and Faults associated with the motor. This routine is provided as a Ladder Diagram.

  - A02_GritTankDrive_FBD contains the Single Speed Motor, Permissives and Interlock AOIs that monitor and control the Grit Tank 01 motor. This routine is provided as a Function Block Diagram.
  - A03_GritTankDrive_Auto contains the Cycle Timer (including the U_RepeatCycTmr AOI) code. This routine is provided as a Ladder Diagram.
  - A04_GritTankFlow contains the Analog Input AOI and U_FlowTot AOI that aggregates the Grit Tank 01 flow. This routine is provided as a Function Block Diagram.
- Wet Well monitors Wet Well level and generates alarms, including:
  - Main routine calls the other routines in this program.
  - A01_Wellwell contains the code to monitor Wet Well level and generates alarms utilizing the Analog (P_AIn) and Discrete (P_Din) Input AOIs. This routine is provided as a Function Block Diagram.

AOI instructions are used extensively in this application. There is a collection of Process Library AOIs and a collection of other AOIs developed specifically for this application. Process Library AOIs can be identified by a prefix "P_" in their name. The other AOIs have a prefix of "U_" as shown in the AOI illustration.

AOIs



Process Description

The Raw Water Intake application consists of Screening, Influent Flow Measurement, and Grit Removal. From the inlet well, the wastewater enters

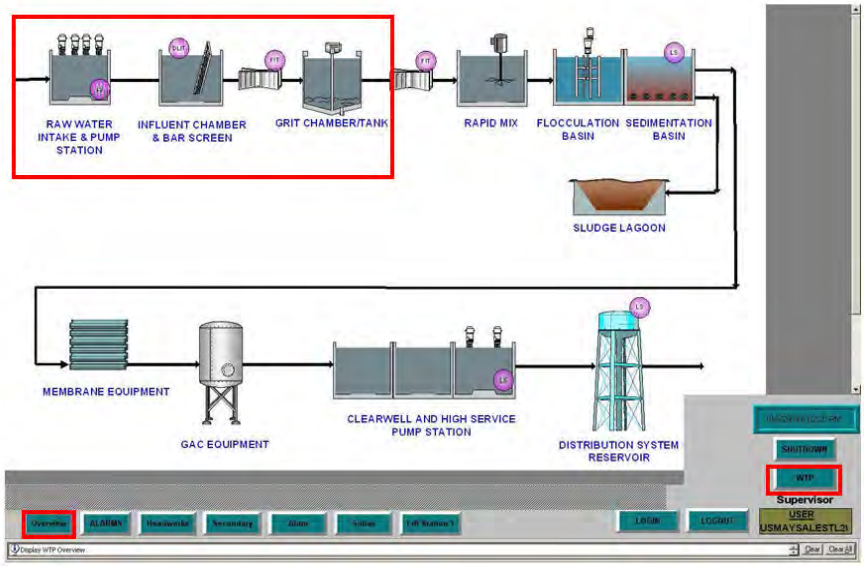
one or two preliminary treatment flow channels. Each flow channel consists of an **Inclined Bar** screen with a mechanical raking device to remove debris from the raw wastewater. The **Mechanical Bar** screens cycle periodically to rake debris from the bar rack and deposit the screenings on a belt conveyor. This conveyor runs during the screening cycle and moves the screenings to the Screenings Compactor which empties into the grit and screen hopper for subsequent disposal.

HMI Description

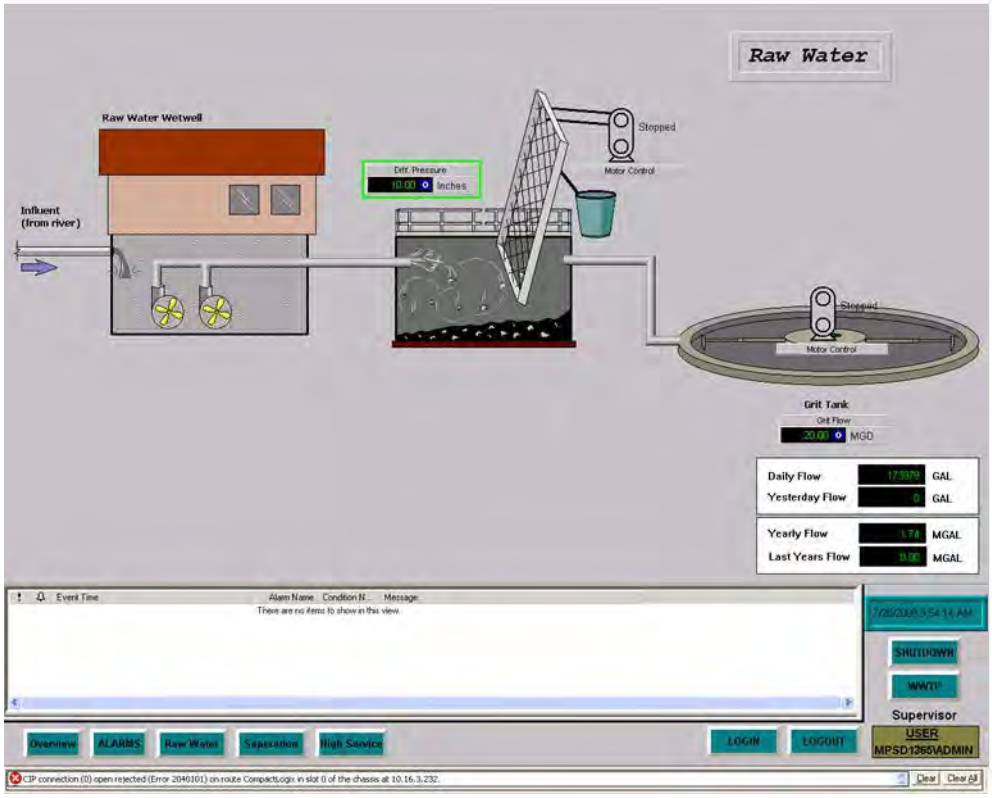
The operator controls and monitor these processes as follows:

1. Click the **WTP** button to go **Water Treatment Plant (WTP) Overview** screen.
2. Click the appropriate **Raw Water Intake & Pump Station** icon to display the **Raw Water Intake & Pump Station Overview** screen. The **Raw Water Intake & Pump Station** icons are enclosed in the large red box on the **WTP Overview** screen.
   – If you want to return to the **WWTP Overview** screen, click the **Overview** button.

Selecting the Raw Water Intake WTP Overview Screen



Raw Water Intake Overview Screen



The status information on the **Raw Water Intake & Pump Station Overview** screen includes:

- **Mechanical Bar** screen Number 1
- Grit Tank Drive Number 1
- Channel Numbers 1 and 2, Differential Level
- Channel Number 1 Flow

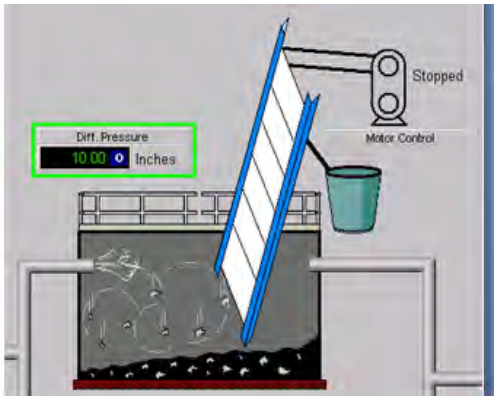
Control Description

This section describes the **Mechanical Bar** screen Number 1 operational mode.

Hand Mode

The **Mechanical Bar** screen Number 1 is operated locally by selecting the Hand position on the Hand-Off-Auto selector switch, which is located at the MCC. The operator uses the **Bar** screen using buttons located at the equipment. In this mode, the operator is responsible for operating the conveyor, compactor, and the Bar screen.

Mechanical Bar Screen



Remote Operator Mode

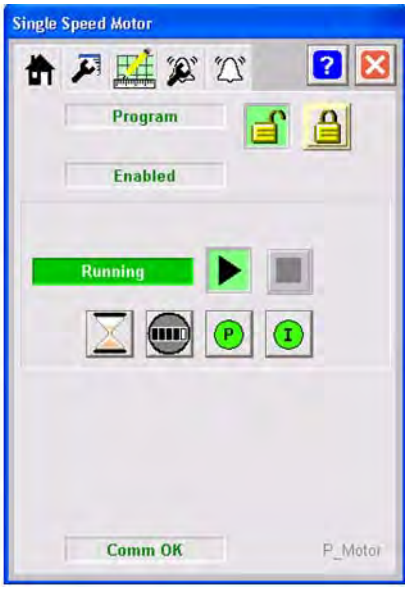
The operator must place the screening equipment in the this mode to use them from the HMI. The operator can place the **Mechanical Bar** screen in the Remote mode by selecting Auto on the Auto-Off-Hand selector switches located at the MCC for each equipment.

In the Remote mode, the operator may select Auto or Manual mode to control the process from the **HMI**.

Operator Mode (Manual)

Click the screening equipment display the **Single Speed Motor** Faceplate.

Single Speed Motor (HMI Equipment Faceplate Template)



For Manual Operator Control, select the Operator mode from the Single Speed Motor **HMI Equipment** Faceplate. The faceplate shown is used to control the screening equipment. The screening equipment is started and stopped remotely from the **HMI Equipment** Faceplate. The available **Bar** screen commands include:

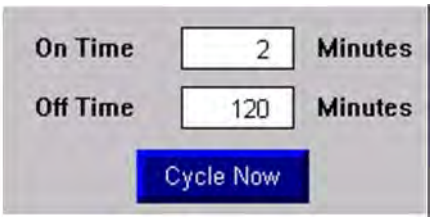
- Press the **Play** button to start the Bar screen.
- Press the **Stop** button to stop the Bar screen.
- Click the **Disable** button to remove the Bar screen from service.
- Click the **Enable** button to place the unit back in service.

Program Mode (Auto)

To place the **Bar s**creen in Program Mode (Auto) control, perform the following:

1. Select Auto on the Auto-Off-Hand selector switches located at the MCC for each equipment to place the Bar screen in the Remote mode.
2. Select Program mode from the **HMI Equipment** Faceplate. When in Remote Program mode, the screening will be called to start when the accumulated time is equal to the Cycle Timer pre-set or the differential level across the screen reaches setpoint.

Bar Screen Cycle Timer



The following sequence will occur when the screening system is run in Auto:

1. The system commands the **Mechanical Bar** screen to start.
2. The **Mechanical Bar** screen will run for 2 minutes before being called to stop.

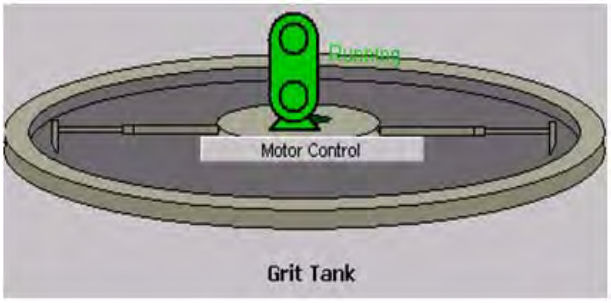
Grit Removal

This section describes the Grit Removal, Hand, Remote Operator, and Program modes.

Hand Mode - Grit Tank Drive (GTD) Number 1

Operate the drive in the Local mode by selecting Hand on the Hand-Off-Auto selector switch located at the MCC. The operator uses the buttons located at the tank to start or stop each drive.

Grit Tank Drive



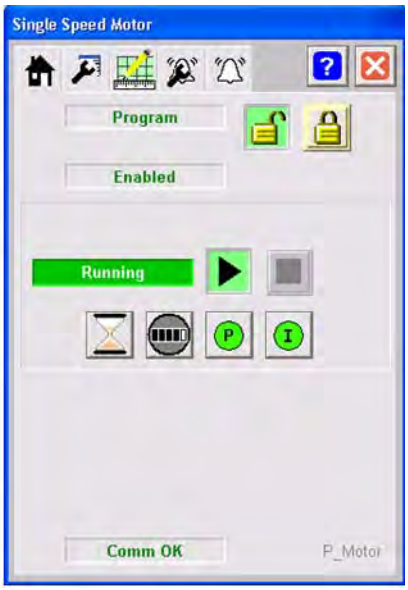
Remote Operator Mode

The operator must place the Grit Tank Drive in the Remote Operator mode to use it from the HMI. The Grit Tank Drive is placed in the Remote mode by selecting Auto on the Auto-Off-Hand selector switches located at the MCC for each equipment. In the Remote mode, the operator may select Auto or Manual mode to control the process from the **HMI Equipment** Faceplate.

Operator Mode (Manual)

Once the operator clicks on the GTD equipment, the system displays a faceplate.

Single Speed Motor (HMI Equipment Faceplate)



The operator uses this faceplate to control the GTD equipment. For Manual Operator Control, select the **Operator** mode from the **HMI Equipment** Faceplate.

The operator starts/stops the GTD equipment remotely from the **HMI Equipment** Faceplate. The available GTD screen commands include:

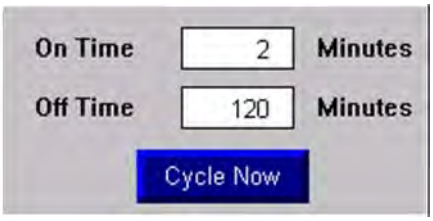
- Press the **Play** button to start the GTD screen.
- Press the **Stop** button to stop the GTD screen.
- Click the **Disable** button to remove the GTD screen from service.
- Click the **Enable** button to place the unit back in service.

Program Mode (Auto)

To place the GTD equipment in Remote Program Mode (Auto) control, perform the following:

1. Select Auto on the Auto-Off-Hand selector switches located at the MCC for each equipment to place the GTD equipment in the Remote mode.
2. Select Program mode from the **HMI Equipment** Faceplate. When in Remote Program mode, the system calls the GTD equipment to start when the accumulated time is equal to the Cycle Timer pre-set.

Bar Screen Cycle Timer



Alarms

The Supervisory Control and Data Acquisition (SCADA) system generates these two types of alarms.

- Process
- Equipment

Process Alarms

- Channel No. 1 Differential Level High alarm

Process Alarms

Equipment Alarms

These are the two types of Equipment Alarms.

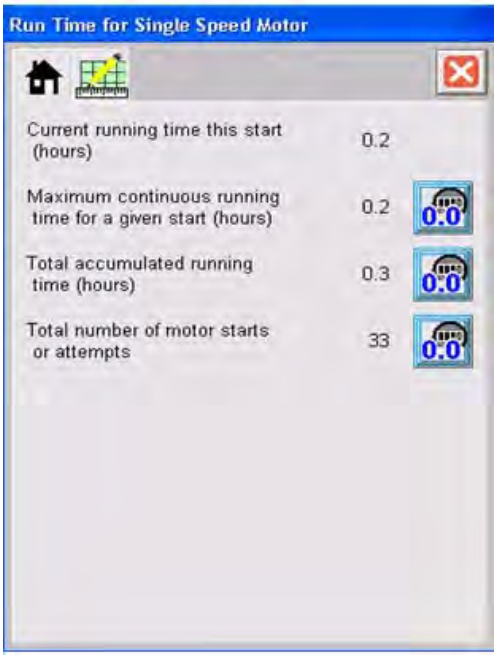
- **Start/Stop Faults** - If the system calls the Mechanical Bar screen and it is not running after 5 seconds, he system generates a Start/Stop Fail Alarm and displays it at the **HMI**.
- **Start/Stop Faults** - If the system calls the GTD to start and is not running after 5 seconds, the system generates a Start/Stop Fail Alarm and displays it at the **HMI**.

Reporting Equipment Run Times

Run times are recoded for the **Mechanical Bar** screen mechanism by the SCADA system. Depending on the user's security level, the total run time maybe reset by clicking on the **Total Reset** button next to the appropriate pump.

- **Mechanical Bar** Screen Number 1
- Grit Tank Drive Number 1

Single Speed Motor Run Time



Customization of the Raw Water Intake Application

General customization notes are included in the Lift Station Application section (page 102) of this chapter. Refer to this section before customizing any application, including the Raw Water Intake. This section describes customization specific to the Raw Water Intake application.

I/O Assignment

As in the Lift Station, I/O is mapped into this application. This is done in the following project locations:

- MainProgram - A01_DiscreteInput - as needed - this routine is provided as a template.
- MainProgram - A02_AnalogInput - as needed - this routine is provided as a template.
- MainProgram - A03_Outputs - as needed - this routine is provided as a template.

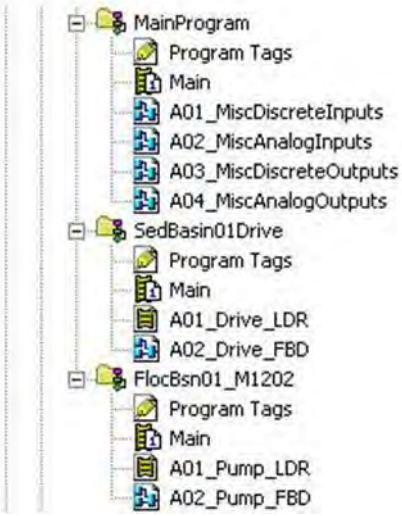
Additional Pumps/Motors (Single Speed Motor AOIs in a FBD Routine)

See the Customization of the Solids Application section for an example of how to add Single Speed Motor AOIs in a FBD routine.

Separation Application

The WWWAT CD contains the Separation application. Refer to the Separation System Application Controller Organization illustration to view the application's organization within the Controller.

Separation System Application Controller Organization



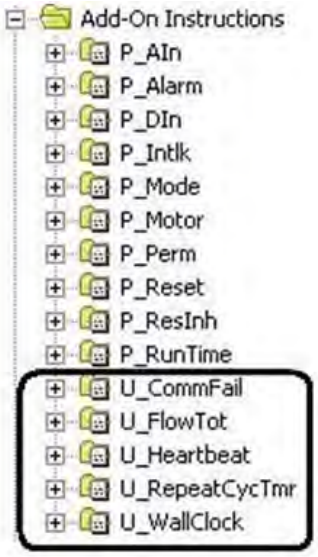
This task resides in a PLC in the main facility of the plant that contains the Separation application and it is not intended to be the only application in the Controller. A ControlLogix processor is specified for this application for that specific reason. It is assumed the processor will be running other plant systems.

The organization of this application is similar to that of other applications in this toolkit. Specifically, the functionality for each program and routine is:

- Main Program handles general separation application and functionality.
  - Main routine calls the other routines in this program and includes a Wall Clock AOI that calculates the day of the week.It also includes a Pump Inputs simulation bit that you can use when testing the application.
  - A01_MiscDiscreteInput provides a template to map inputs that are relevant throughout the secondary. This routine is provided as a Function Block Diagram.
  - A02_MiscAnalogInput provides a template to map analog inputs that are relevant throughout the secondary. This routine is provided as a Function Block Diagram.
  - A03_MiscDiscreteOutputs provides a template to map outputs that are relevant throughout the secondary. This routine is provided as a Function Block Diagram.
  - A04_MiscAnalogOutput provides a template to map analog inputs that are relevant throughout the secondary. This routine is provided as a Function Block Diagram.
- SedBasin01Drive controls the Sedimentation Basin's Sludge Collection Drive motor.
  - Main routine calls the other routines in this program.
  - A01_Drive _LDR contains the code to map fault inputs, hand mode, and resets for the Sedimentation Basin's Sludge Collection Drive motor. This routine is provided as a Ladder Diagram.
  - A02_Drive_FBD contains the Single Speed Motor, Permissives, and Interlock AOIs that monitor and control the Sedimentation Basin's Sludge Collection Drive motor. (See the Using Add-On Instructions section for more information). This routine is provided as a Function Block Diagram.
- FlocBsn01_M1202 controls the Flocculation Mixer motor.
  - Main routine calls the other routines in this program.
  - A01_Pump_LDR contains the code to configure the source of the speed reference for the VFD for the Flocculation Mixer and reset alarms, interlocks and faults associated with the mixer. This routine is provided as a Ladder Diagram.
  - A02_Pump_FBD contains the Variable Speed Drive, Permissives, and Interlock AOIs that monitor and control the Flocculation Mixer motor (See the Using Add-On Instructions section for more information). This routine is provided as a Function Block Diagram.

Add-On Instructions are used extensively in this application. There is a collection of Process Library AOIs and a collection of other AOIs developed specifically for this application. Process Library AOIs can be identified by a prefix "P_" in their name. The other AOIs have a prefix of "U_" as shown in the AOI illustration.

AOIs



Process Description

Raw water, especially river water, contains both dissolved and suspended particles. Coagulation and flocculation processes are used to enlarge and separate the suspended solids portion from the water. The Separation application process consists of:

- Rapid Mix
- Flocculation
- Sedimentation.

Rapid Mix

The Rapid Mix process destabilizes the particle's charges. Before the raw water enters the Rapid Mix area coagulants are added to the water to neutralize the negative charges on suspended solids. Once the charge is neutralized, the small suspended particles stick together. The high-energy Rapid Mix process disperses the coagulant and promotes particle collisions, which is needed to achieve good coagulation.

Flocculation

Directly downstream of the rapid mix process is the Flocculation process. Flocculation is a gentle mixing of the raw water to increase the particle size from submicroscopic to visible suspended particles.

Sedimentation

Sedimentation basins are used to settle out the floc before going to the filters. The inlet to the basin is designed to distribute water evenly, at uniform velocities. The sludge collection drive, removes the sludge from the bottom of the basin, and allows pumps to transfer the sludge to holding tanks.

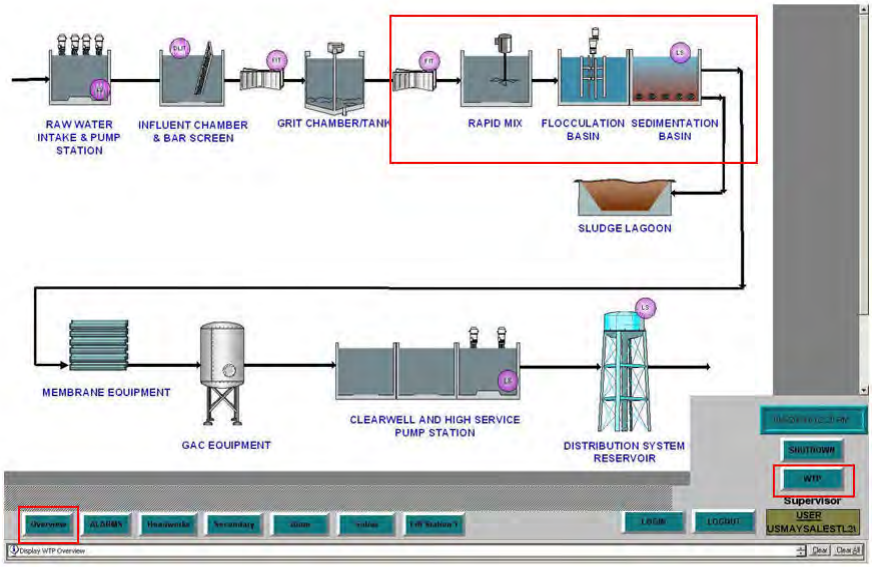
The Separation process (Flocculation and Sedimentation) is controlled by the PLC located in the Chemical Building.

HMI Description

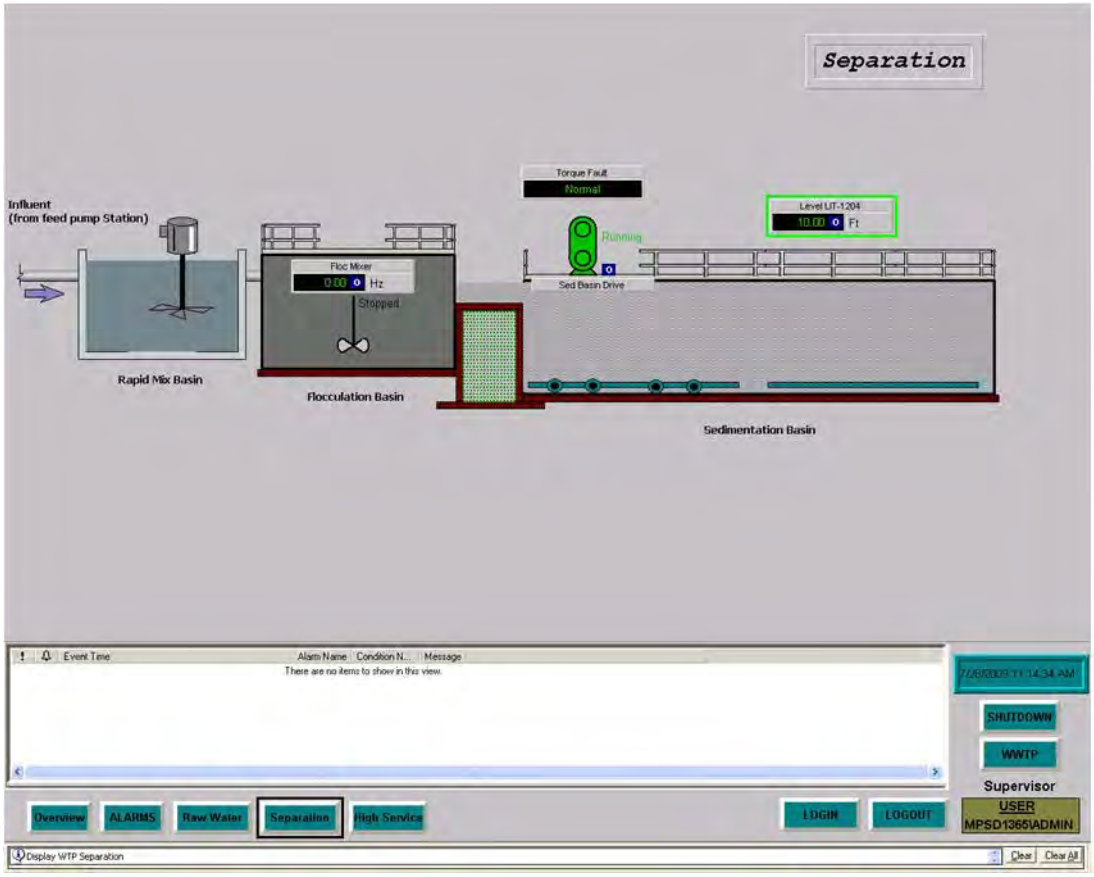
The operator controls and monitors these processes as follows:

1. Click the **WTP** button to go **Water Treatment Plant (WTP) Overview** screen.
2. Click the appropriate **Separation** icon to display the **Separation Overview** screen. The **Separation** icons are enclosed in the large red box on the **WTP Overview** screen.
   – If you want to return to the **WWTP Overview** screen, click the **Overview** button.

Selecting the Separation WTP Overview Screen



Separation Overview Screen



The status information on the **Separation Overview** screen includes:

- Flocculation Mixer Mechanism
- Sludge Mechanism

Control Description

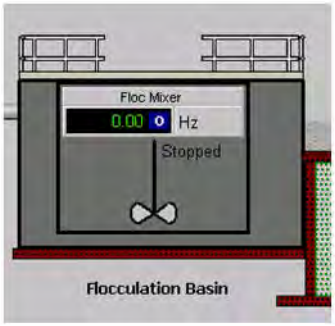
Flocculation Mixer Mechanism

Plant operators control the Flocculation Mixer manually. A VSD powers the mixer, which allows operators to adjust its speed.

Hand Mode

Select Hand on the Hand-Off-Auto selector switch (located at the **VSD**) to operate the mixer locally. The operator uses the buttons located at the **VSD** to operate it.

Selecting the Flocculation Basin on the Separation Overview Screen



Remote Operator Mode

Select the Auto position on the Auto-Off-Hand selector switches located at the **VSD** to put the mixer in the Remote mode. Select the operating state (On/Off) and set the speed on the **VSD** Faceplate.

Operator Mode (Manual)

Click on the **Flocculation Mixer** section of the **Separation Overview** screen. The system displays the **VSD** Faceplate.

VSD Faceplate

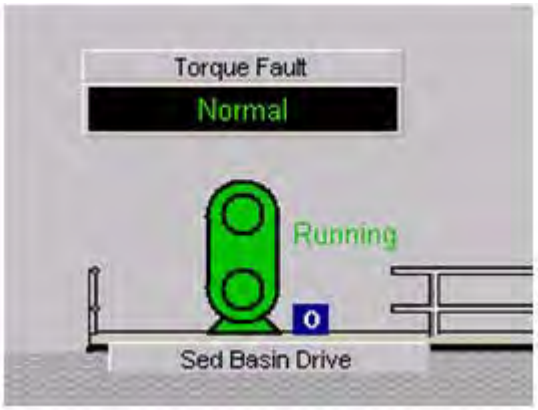
For manual Operator Control, select the **Operator** mode on the **VSD** Faceplate. The operator uses the faceplate shown to control the mixer. The operator starts/stops the mixer remotely from the **VSD** Faceplate. The available faceplate commands include:

- Press the **Play** button to start the mixer.
- Press the **Stop** button to close the mixer.
- Click the **Disable** button to remove the mixer from service.
- Click the **Enable** button to place the unit back in service.

Sedimentation

Plant operators control the Sludge Collection Mechanism (SCM) manually. As the sludge settles to the bottoms of the basin, a rack system collects the sludge for processing.

Sedimentation Basin Drive on the Separation WTP Overview Screen



Hand Mode

Select Hand on the Hand-Off-Auto selector switch (located at the MCC) to operate the SCM locally. The operator uses the buttons located at the MCC to operate it.

Remote Operator Mode

Select the Auto position on the Auto-Off-Hand selector switches located at the MCC to put the SCM drive in the Remote mode.

Operator Mode (Manual)

Click the SCM section of the Solids Overview screen. The system displays the **Sedimentation Basin 1 Drive** Faceplate.

Sedimentation Basin 1 Drive Faceplate

For manual **Operator Control, s**elect the **Operator** mode on the **Sedimentation Basin 1 Drive** Faceplate. The Operator uses this faceplate to control the SCM. The operator starts and stops the SCM remotely from the faceplate. The available faceplate commands include:

- Press the **Play** button to start the SCM.
- Press the **Stop** button to stop the SCM.
- Click the **Disable** button to remove the SCM from service.
- Click the **Enable** button to place the unit back in service.

Alarms

The Supervisory Control and Data Acquisition (SCADA) system generates these two types of alarms.

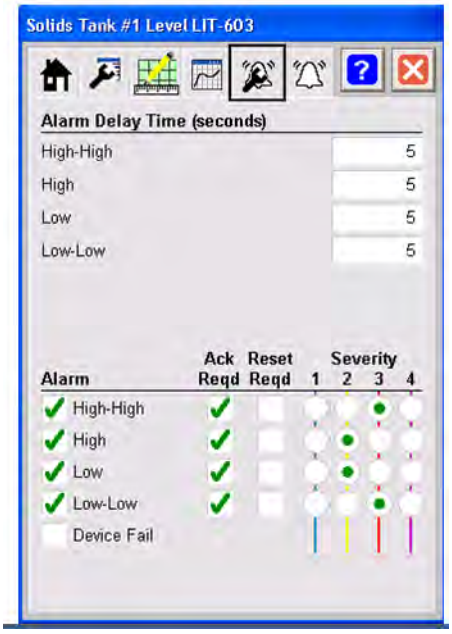
- Process
- Equipment

Process Alarms

There are the four types of Process Alarms.

- Sedimentation Basin LIT-1204 High Level Alarm
- Sedimentation Basin LIT-1204 Low Level Alarm
- Sedimentation Basin LIT-1204 High-High Level Alarm
- Sedimentation Basin LIT-1204 Low-Low Level Alarm

Process Alarms



Equipment Alarms

These are the two types of Equipment Alarms.

- **Start/Stop Faults** - If the PLC commands the Flocculation Mixer to start and it is not running after 5 seconds, it generates a **Start/Stop Fail** alarm at the HMI.
- **Start/Stop Faults** - If the PLC commands the SCM to start and it is not running after 5 seconds, it generates a **Start/Stop Fail** alarm at the HMI.
- **SCM Fault** - this is a contact from the SCM, and once opened, the PLC generates a SCM Fault alarm at the HMI

Reporting

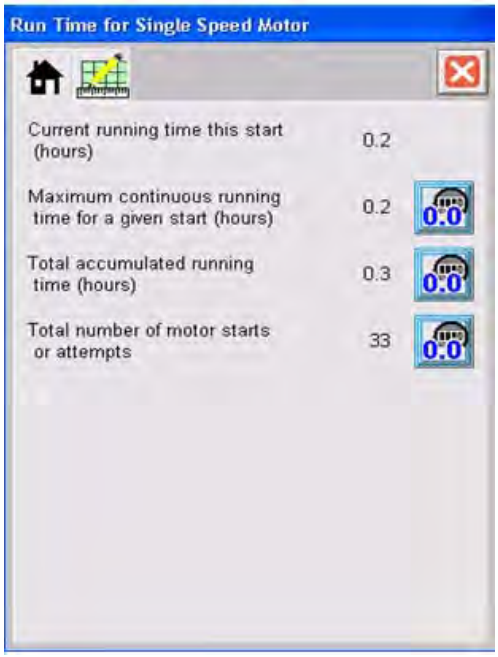
The SCADA system records:

- Process - The system will trend common signals and record them for future viewing, including:
  - Sedimentation Basin Level LIT-1204
- Equipment Runtimes

  The SCADA system records run times for the blower and SCST Drive Mechanism. Depending on the user's security level, the total runtime may be reset by clicking on the **Total Reset** button next to the appropriate pump.

  - Flocculation Mixer
  - SCM

Single Speed Motor Run Time



Customization of the Separation Application

General customization notes are included in the Lift Station Application section (page 102) of this chapter. Refer to this section before customizing any application, including the Separation. This section describes customization specific to the Separation application.

I/O Assignment

As in the Lift Station, I/O is mapped into this application. This is done in the following project locations

- MainProgram - A01_DiscreteInput - as needed - this routine is provided as a template.
- MainProgram - A02_AnalogInput - as needed - this routine is provided as a template.
- MainProgram - A03_Outputs - as needed - this routine is provided as a template.
- MainProgram - A04_AnalogOuput - as needed - this routine is provided as a template.

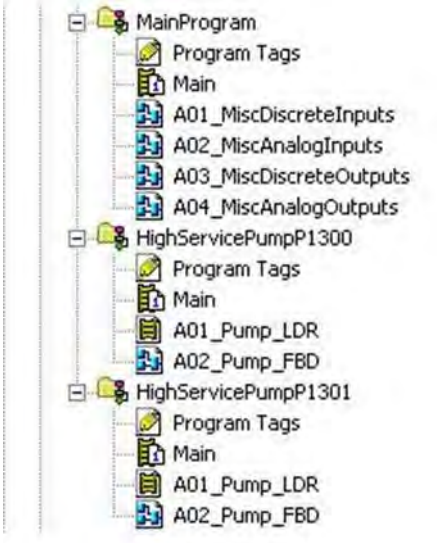
Additional Pumps/Motors (Single Speed Motor AOIs in a FBD Routine)

See the Customization of the Solids Application section the Solids application for an example of how to add Single Speed Motor AOIs in a FBD routine.

High Service Pump Station Application

The High Service Pump Station application is provided on the WWWAT CD. Refer to the High Service Pump Station System Application Controller Organization illustration to view the application's organization within the Controller.

High Service Pump Station System Application Controller Organization



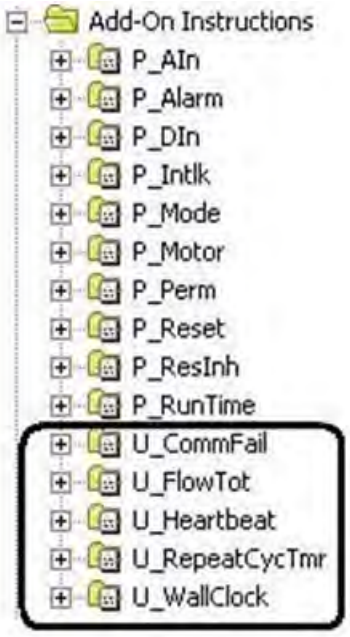
This task should reside in a Controller in the main facility of the plant where the High Service Pump Station application is present and it is not intended to be the only application in the Controller. A ControlLogix processor is specified for this application for that specific reason. It is assumed the processor will be running other systems of the plant.

The organization of this application is similar to that of the other applications in this toolkit. Specifically, the functionality for each program and routine is:

- Main Program handles general High Service Pump Station application and functionality, including:
  - Main routine calls the other routines in this program and includes a Wall Clock AOI that calculates the day of the week. It also includes a Pump Inputs simulation bit that you can use when testing the application.
  - A01_MiscDiscreteInput includes a template to map inputs that are relevant throughout the High Service Pump Station system. This routine is provided as a Function Block Diagram.
  - A02_MiscAnalogInput includes a template to map analog inputs that are relevant throughout the High Service Pump Station system. This routine is provided as a Function Block Diagram.
  - A03_MiscOutputs includes a template to map outputs that are relevant throughout the High Service Application. This routine is provided as a Function Block Diagram
  - A04_MiscAnalogOutput provides a template to map analog inputs that are relevant throughout the High Service Application. This routine is provided as a Function Block Diagram.
  - HighServicePumpP1300 controls the High Service Pump 1300.
  - A01_Pump _LDR contains the code to configure the source of the speed reference for the VFD for the High Service Pump 1300 and reset alarms, interlocks and faults associated with the pump. This routine is provided as a Ladder Diagram.
  - A02_Pump_FBD contains the Variable Speed Drive, Permissives and Interlock AOIs that monitor and control the High Service Pump 1300. (See the Using Add-On Instructions section for more information). This routine is provided as a Function Block Diagram.
- HighServicePumpP1301 Controls the High Service Pump 1301 as described for the High Service Pump 1300.

AOIs are used extensively in this application. There is a collection of Process Library AOIs and a collection of other AOIs developed specifically for this application. Process Library AOIs can be identified by a prefix "P_" in their name. The other AOIs have a prefix of "U_" as shown in the AOI illustration.

AOIs



Process Description

The High Service Pump Station process consists of a Clear Well, High Service Pumps, and Elevated Tank.

Clear Well

Clear Well Storage (CWS) should be sized, in conjunction with distribution system storage, to relieve the filters from having to follow fluctuations in water use.

High Service Pumps

The High Service Pumps (HSPs) deliver water to the Distribution System (DS). The DS is the elements of the municipal waterworks between the treatment facility and the consumer. The function of the DS is to deliver water under reasonable pressure in volumes adequate to meet peak consumer demands in the service area.

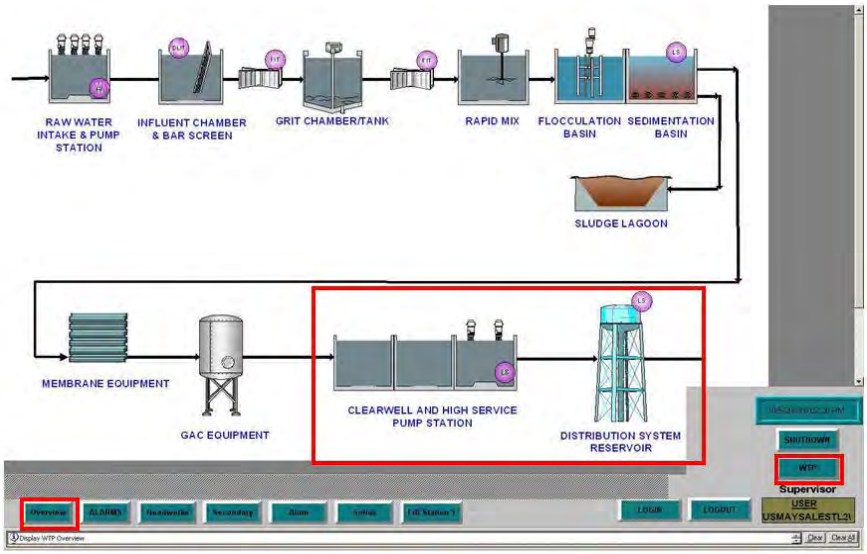
The PLC controls the High Service Pump Station process (Clear Well, High Service Pumps, and Elevated Tank) and it is located in the Operations Building.

HMI Description

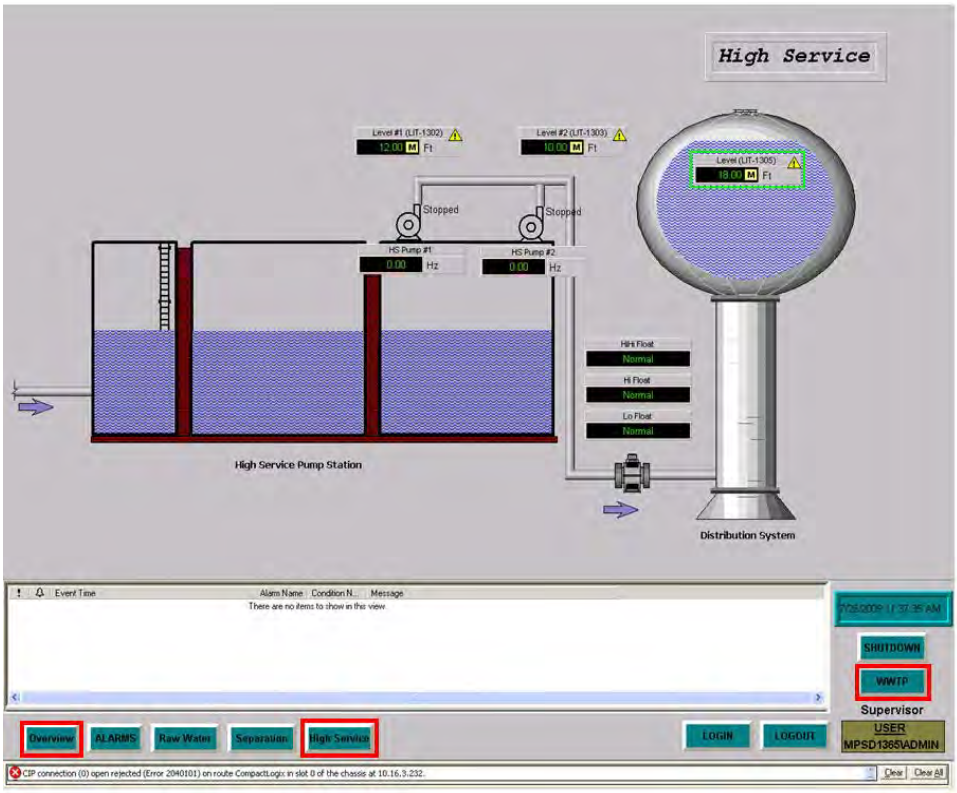
The operator controls and monitors these processes as follows:

1. Click the **WTP** button to go **Water Treatment Plant (WTP) Overview** screen.
2. Click the appropriate **High Service Pump Station** icon to display the **High Service Pump Station Overview** screen. The **High Service Pump Station** icons are enclosed in the large red box on the **WTP Overview** screen.
   – If you want to return to the **WWTP Overview** screen, click the **Overview** button.

Selecting the High Service Pump Station WTP Overview Screen



High Service Pump Station System Overview Screen



The status information on the **High Service Pump Station Overview** screen includes:

- Clearwell Level LIT-1302
- Clearwell Level LIT-1303
- High Service Pump 1300
- High Service Pump 1301
- Elevated Tank Level LIT-1305
- Clearwell High-High Float
- Clearwell High Float
- Clearwell Low High Float

Control Description

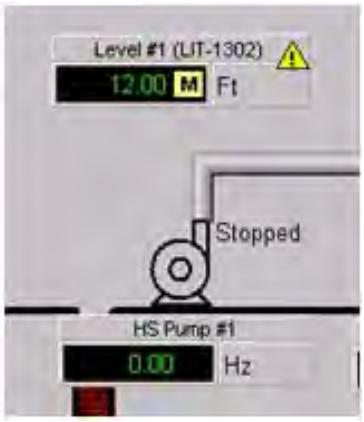
High Service Pumps

The High Service pumps are variable frequency drive controlled, which allows their speed to be throttled. The flow of drinking water is controlled by varying the speed of these pumps. The system only requires one pump for peak demand, plus elevated tank filling.

Hand Mode

Select Hand on the Hand-Off-Auto selector switch (located at the **VSD**) to operate the pumps locally. The operator uses the buttons located at the **VSD** to operate it.

High Service Pump (Lit-1302)



Remote Operator Mode

The operator must place the pumps in this mode to use them from the **HMI.** The operator can place the pumps in the Remote mode by selecting Auto on the Auto-Off-Hand selector switches located at the VSD for each equipment. In Remote mode, the operator selects **Program** mode to control the process from the **HMI**.

Operator Mode (Manual)

Click the **High Service Pump** icon to display the **High Service Pump #1 (M-1300) Faceplate**.

High Service Pump #1(M-1300) Faceplate (HMI Template)

For Manual Operator Control, select the **Operator** mode from the **High Service Pump #1 (M-1300)** Faceplate. Operators use this faceplate to control the pump equipment remotely. The available commands include:

- Press the **Play** button to start the pump.
- Press the **Stop** button to stop the pump.
- Click the **Disable** button to remove the pump from service.
- Click the **Enable** button to place the unit back in service.

Alarms

The Supervisory Control and Data Acquisition (SCADA) system generates these two types of alarms.

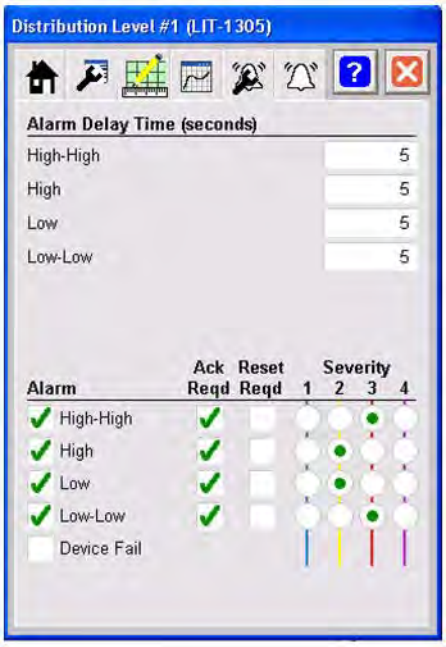
- Process
- Equipment

Process Alarms

There are the fifteen types of Process Alarms.

- Clearwell Level LIT-1302 High Alarm
- Clearwell Level LIT-1302 Low Alarm
- Clearwell Level LIT-1302 High-High Alarm
- Clearwell Level LIT-1302 Low-Low Alarm
- Clearwell Level LIT-1303 High Alarm
- Clearwell Level LIT-1303 Low Alarm
- Clearwell Level LIT-1303 High-High Alarm
- Clearwell Level LIT-1303 Low-Low Alarm
- Clearwell Level Float Low Water Cutoff
- Clearwell Level Float LSH-1307 High Alarm
- Clearwell Level Float LSHH-1308 High High Alarm
- Elevated Tank Level LIT-1305 High Alarm
- Elevated Tank Level LIT-1305 Low Alarm
- Elevated Tank Level LIT-1305 High-High Alarm
- Elevated Tank Level LIT-1305 Low-Low Alarm

Process Alarms



Equipment Alarms

These are the two types of Equipment Alarms.

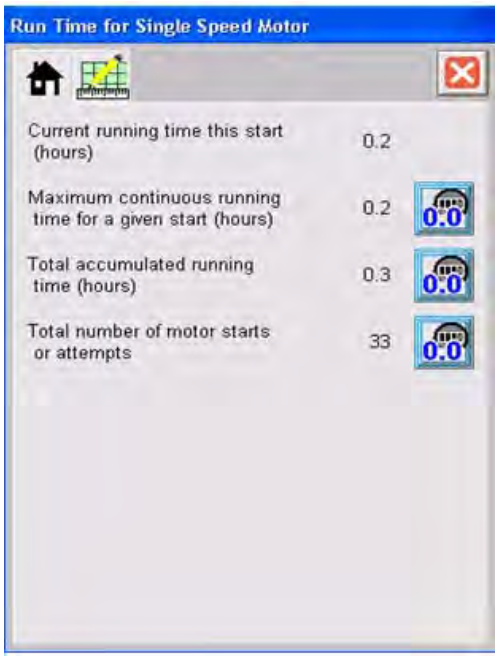
- **High Service Pump #1 VFD Fault** - This is a messaged fault from the VSD drive unit. Once the PLC receives the fault message, it generates a VSD alarm at the **HMI**.
- **High Service Pump #2 VFD Fault** - This is a messaged fault from the VFD drive unit. Once the PLC receives the fault message, it generates a VFD alarm at the **HMI.**

Reporting

The SCADA system records:

- Process - The system will trend common signals and record them for future viewing, including:
  - High Service Pump P-1300
  - Output Frequency
  - Command Frequency
  - High Service Pump P-1301
  - Output Frequency
  - Command Frequency
- Equipment Runtimes
- Runtimes are recorded for the blower and clarifier center drive mechanism by the SCADA system. Depending on the user's security level, the total runtime may be reset by clicking on the **Total Reset** button next to the appropriate pump.
  - High Service Pump 1
  - High Service Pump 2

Single Speed Motor Run Time



Customization of the High Service Pump Station Application

General customization notes are included in the Lift Station Application section (page 102) of this chapter. Refer to this section before customizing any application, including the High Service Pump Station. This section describes customization specific to the High Service Pump Station.

I/O Assignment

As in the Lift Station, I/O is mapped into this application. This is done in the following project locations:

- MainProgram - A01_DiscreteInput - as needed - this routine is provided as a template.
- MainProgram - A02_AnalogInput - as needed - this routine is provided as a template.
- MainProgram - A03_Outputs - as needed - this routine is provided as a template.

Additional Pumps/Motors (Single Speed Motor AOIs in a FBD Routine)

See the Solids application's Customization of the Solids Application section for an example of how to add Single Speed Motor AOIs in a FBD routine.

Pump Controller Station

WWWAT CD

Select Pump Controller Station from the WWWAT CD Main Menu to locate this application

Introduction

The multifunction pump controller station package is designed to be a stand alone versatile control system that allows the user the ability to choose between a pump down (lift station), pump up (water tank) or a pressure follower (water distribution) control process, with just a few simple screen selections. The control combines the power and functionality of a MicroLogix 1400 PLC and the versatility of a PanelView component HMI.

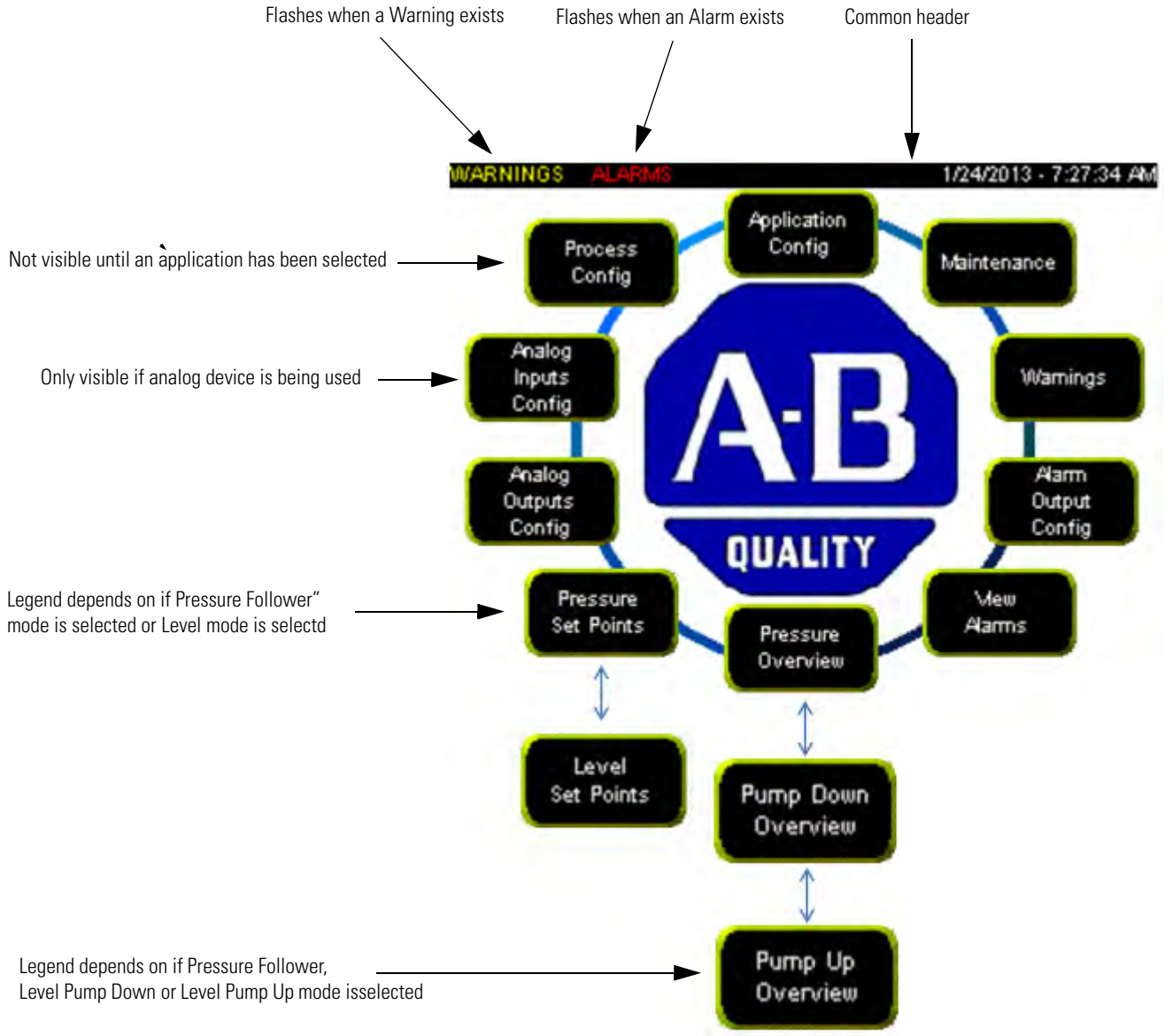
Engineering cost is kept low because the user only needs to configure parameters instead of developing control programs.

Functionality includes:

- Control of up to 4 pumps
- User assignable inputs
- Use of floats, analog or a combination of both to control the process

- Control of VFD'sthrough Modbus communication, which reduces the control wiring to the drives (PowerFlex 4/40/400 VFD's only)
- Pump control can be done with starters, PowerFlex 4 series VFD's or with another manufactures VFD
- Pump sequencing control
- User selectable alarms with the ability to choose which ones can be used to initiate an alarm dialer (user supplied)
- Pump statistics
- The ability to save and load VFD parameters from the HMI. (PF4 vfd's only)
- Selectable pump interlocks

Main Screen


Flashes when a Warning exists
Flashes when an Alarm exists
Common header
WARNINGS
ALARMS
1/24/2013 - 7:27:34 AM
Application Config
Process Config
Maintenance
Analog Inputs Config
Warnings
Analog Outputs Config
Alarm Output Config
QUALITY
Pressure Set Points
Pressure Overview
View Alarms
Level Set Points
Pump Down Overview
Pump Up Overview
Not visible until an application has been selected
Only visible if analog device is being used
Legend depends on if Pressure Follower" mode is selected or Level mode is selectd
Legend depends on if Pressure Follower, Level Pump Down or Level Pump Up mode isselected

The main screen displays configuration, monitoring and maintenance controls. Some control label content displays based on the current configuration.

Several of the buttons on the Main screen do not display until the application has been set up. So the first step is to go through the **Application Config** button.

Configuring the Application

The functions available when you select the **Application Config** button include:

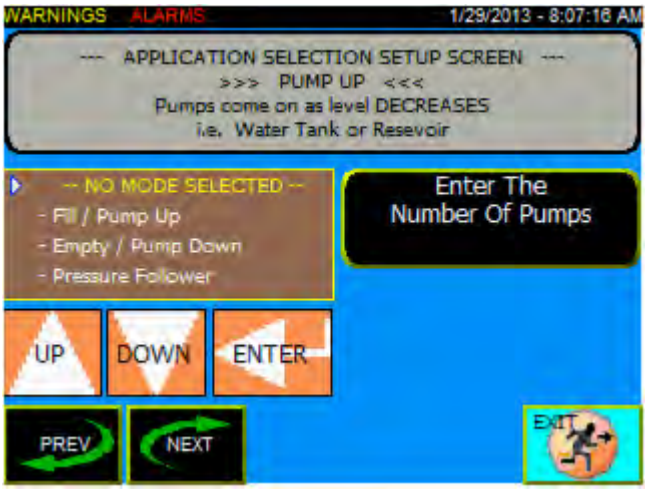
- Select the pumps and pump modes
- Select primary and secondary measuring devices
- Select control devices for all active pumps
- Assign digital inputs and their states
- Assign backup pumps

Each of the configuration screens contains standard navigational tools:

- Press **Prev** or **Next** to navigate between screens.
- Press **Up**, **Down**, or **Enter** to navigate available choices on a single screen.
- Press **Exit** to return to the **Main** menu.

To use the configuration controls:

1. From the Main screen, press **Application Config** to display the configuration screen.

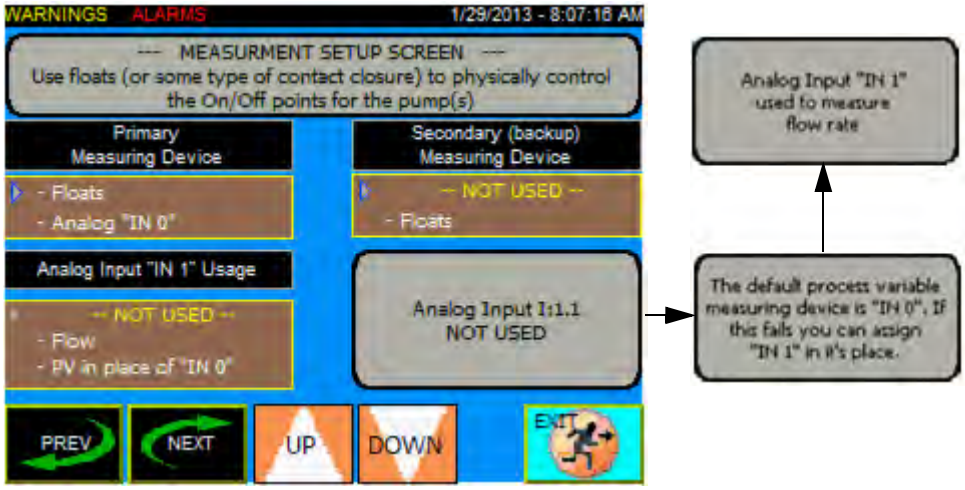


   From the configuration screen you can:

   – Use the **Up**/**Down**/**Enter** buttons to select from the three available operation modes

– Press **Enter The Number Of Pumps** to select the number of pumps (1-4) in use in the system
– View a description of the selected mode

2. Press **Next** to proceed to the **Measuring Setup** screen.


WARNINGS ALARMS
1/29/2013 - 8:07:16 AM
--- MEASURMENT SETUP SCREEN ---
Use floats (or some type of contact closure) to physically control the On/Off points for the pump(s)
Primary Measuring Device
- Floats
- Analog "IN 0"
Secondary (backup) Measuring Device
-- NOT USED --
- Floats
Analog Input "IN 1" Usage
-- NOT USED --
- Flow
- PV in place of "IN 0"
Analog Input I:1.1 NOT USED
PREV
NEXT
UP
DOWN
EXIT
Analog Input "IN 1" used to measure flow rate
The default process variable measuring device is "IN 0". If this fails you can assign "IN 1" in it's place.

From the **Measuring Setup** screen you can:

– Use the **Up/Down** buttons to select the primary measuring device.

TIP

If **Pressure Follower** mode is selected then **Analog "In 0"** is the only option for the primary measuring device.

– Select a secondary measuring device

TIP

If the primary measuring device is an analog device, you can assign a float to be used as backup (not available if primary measuring is floats).

– Use the second analog input (IN 1) to measure flow rate from an analog transmitter or as the process variable if the default analog input (IN 0) fails.

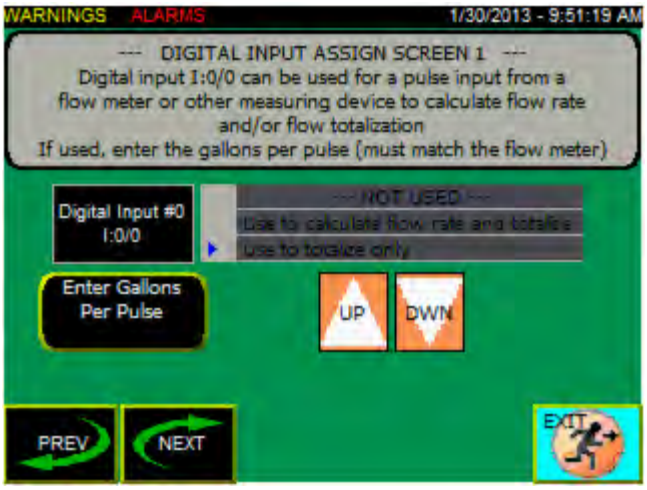
When analog input "IN 1" (I:1.1) is set for **Flow** the flow is totalized using a calculation in the PLC. A more accurate way to totalize would be to use digital input I:0/0 as a totalized pulse.

3. Press **Next** to proceed to the **Motor Control Setup** screen. In the example shown, four pumps have been configured; the screen will only display as many pumps as you set up in the initial configuration screen.

From the **Motor Control Setup** screen you can use the **Up/Down** buttons to select the pump control device.

The **Starter** and **Other VFD** selections use physical outputs from the PLC to control the start/stop operation of the motors, while the **PowerFlex 4** option uses Modbus communication to control the VFD.

4. Press **Next** to proceed to the first **Digital Inputs Assign** screen. There are four **Digital Inputs Assign** screens in total.


WARNINGS ALARMS
1/30/2013 - 9:51:19 AM
--- DIGITAL INPUT ASSIGN SCREEN 1 ---
Digital input I:0/0 can be used for a pulse input from a
flow meter or other measuring device to calculate flow rate
and/or flow totalization
If used, enter the gallons per pulse (must match the flow meter)
Digital Input #0
I:0/0
--- NOT USED ---
Use to calculate flow rate and totalize
Use to totalize only
Enter Gallons
Per Pulse
UP
DWN
PREV
NEXT
EXIT

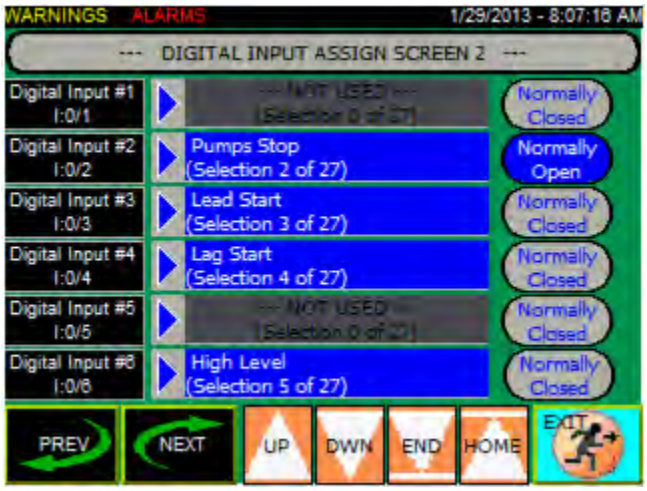
From the first **Digital Inputs Assign** screen you can:

– Use **Digital input I:0/0** as a pulsed input to totalize flow only or to totalize flow and calculate a flow rate.

As a flow totalizer this can be very accurate. However, using it to calculate flow rate is not as accurate as using analog input I:1.1 as a flow rate input.

– Press **Enter Gallons Per Pulse** to set the appropriate gallons per input pulse

5. Press **Next** to proceed to the next **Digital Inputs Assign** screen.



From the remaining **Digital Inputs Assign** screens you can:

– Press **Normally Open** or **Normally Closed** to set the state to match the way the digital input is wired on the field device.

– Use the **Up**/**Down** and **End**/**Home** buttons to scroll through the list of selections

– Digital inputs **I:0/0 – I:0/17** are assignable to any of the 27 selections listed; however, depending on the application, they may not all be applicable. For example, if you only have two pumps in your system, selection #20 Pump 3 seal fail would not apply . ---

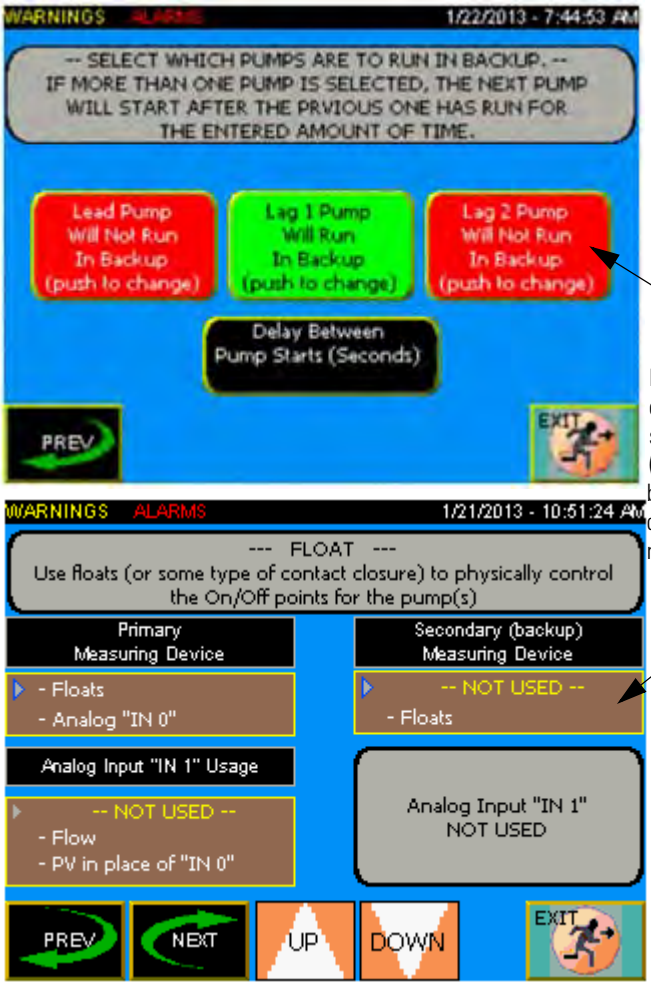
NOT USED --- (Selection 0 of 27)	Pump 4 Running (Selection 9 of 27)	Pump 1 Seal Fail (Selection 18 of 27)
Low Level (Selection 1 of 27)	Pump 1 OL/Fault (Selection 10 of 27)	Pump 2 Seal Fail (Selection 19 of 27)
Pumps Stop (Selection 2 of 27)	Pump 2 OL/Fault (Selection 11 of 27)	Pump 3 Seal Fail (Selection 20 of 27)
Lead Start (Selection 3 of 27)	Pump 3 OL/Fault (Selection 12 of 27)	Pump 4 Seal Fail (Selection 21 of 27)
Lag Start (Selection 4 of 27)	Pump 4 OL/Fault (Selection 13 of 27)	Low Pressure (Selection 22 of 27)
High Level Selection 5 of 27)	Pump 1 Motor Over Temp (Selection 14 of 27)	High Pressure (Selection 23 of 27)

Pump 1 Running (Selection 6 of 27)	Pump 2 Motor Over Temp (Selection 15 of 27)	Power failure (Selection 24 of 27)
Pump 2 Running (Selection 7 of 27)	Pump 3 Motor Over Temp (Selection 16 of 27)	Generator Running (Selection 25 of 27)
Pump 3 Running (Selection 8 of 27)	Pump 4 Motor Over Temp (Selection 17 of 27)	Generator Fault (Selection 26 of 27)
		General Fault (Selection 27 of 27)

– Press **Next** to proceed to the **Backup Pump Select** screen.

TIP

The **Backup Pump Selection** screen is visible only if **Float** is selected as the backup on the **Measuring Setup** screen.


WARNINGS ALARMS
1/22/2013 - 7:44:53 AM
-- SELECT WHICH PUMPS ARE TO RUN IN BACKUP. --
IF MORE THAN ONE PUMP IS SELECTED, THE NEXT PUMP WILL START AFTER THE PRVIOUS ONE HAS RUN FOR THE ENTERED AMOUNT OF TIME.
Lead Pump Will Not Run In Backup (push to change)
Lag 1 Pump Will Run In Backup (push to change)
Lag 2 Pump Will Not Run In Backup (push to change)
Delay Between Pump Starts (Seconds)
PREV
EXIT
WARNINGS ALARMS
1/21/2013 - 10:51:24 AM
--- FLOAT ---
Use floats (or some type of contact closure) to physically control the On/Off points for the pump(s)
Primary Measuring Device
- Floats
- Analog "IN 0"
Secondary (backup) Measuring Device
-- NOT USED --
- Floats
Analog Input "IN 1" Usage
-- NOT USED --
- Flow
- PV in place of "IN 0"
Analog Input "IN 1" NOT USED
PREV
NEXT
UP
DOWN
EXIT

If during the measuring device setup, floats are selected as secondary (backup) then these buttons will enable or disable the pumps from running in backup mode.

Press the **Delay Between Pump Starts (Seconds)** to enter the delay before the next one starts when more than one backup pump is enabled.

TIP

If on the "Measuring Setup" screen (above) the "Secondary (backup) Measuring Device" is set to "NOT USED", then no pumps will run in backup.

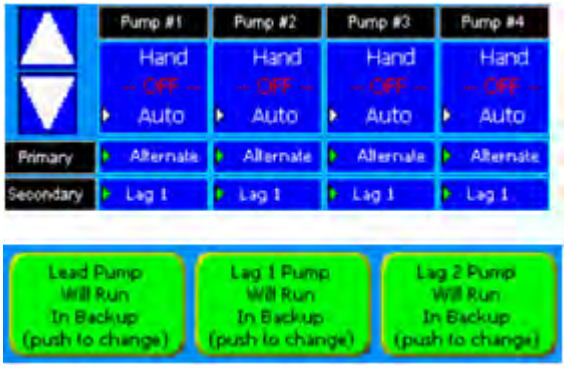
TIP

If on the "Measuring Setup" screen (above) the "Secondary (backup) Measuring Device" is set to "Floats", then backup pumps will start when the "Lead Start" float is activated, and continue until the "Pumps Stop" float is activated.

A "lead start" and a "pumps stop" selection must be assigned to an input on one of the "Digital Input Assign" screens.

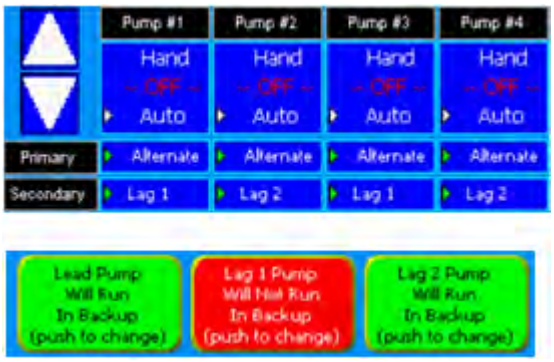
Because this is a backup operation likely due to a failure, the pumps do not alternate.

Setup Examples



Example 1: In a pump down application. Floats are being used as backup. On the P**ump Sequence Setup** screen, the **Primary** selection for all pumps is set to **Alternate**, and the **Secondary** selections are set to **Lag1**. And on the **Backup Pump Selection** screen, lead, lag1 and lag2 pumps are all allowed to run as backup. As the level rises and activates the **Lead Start** float. The lead pump (because all are set for alternate, it could be any of the four pumps) starts. Let's say that the **Delay Between Pump Starts** (see graphic above) is set for 60 sec. If the **Pumps Stop** float does not clear in this time, all of the pumps assigned to **Lag1** as **Secondary** will start (in this case all of them). If a pump was set to **Lag2** as the **Secondary** selection, it will start 60 sec. after the **Lag1** pump(s) start. If all of the pumps are set to **Lag2** as **Secondary**, then no pumps will start during the first 60 sec. (Lag1 time). The sequence is: lead pump --- delay --- lag1 pump(s) --- delay --- lag2 pump(s). Once a pump starts, it will continue to run until the **Pumps Stop** float clears.

Example 2: Same setup as above except the **Secondary** selections are now as shown. Let's say that pump 2 is the lead pump. **Lead Start** float is activated. Pump 2 starts --- 60 sec. time delay --- pump 1 (lag1) starts --- 60 sec. time delay --- pump 3 (lag2) starts. Because pump 4 is set to **Not Used** it does not run.



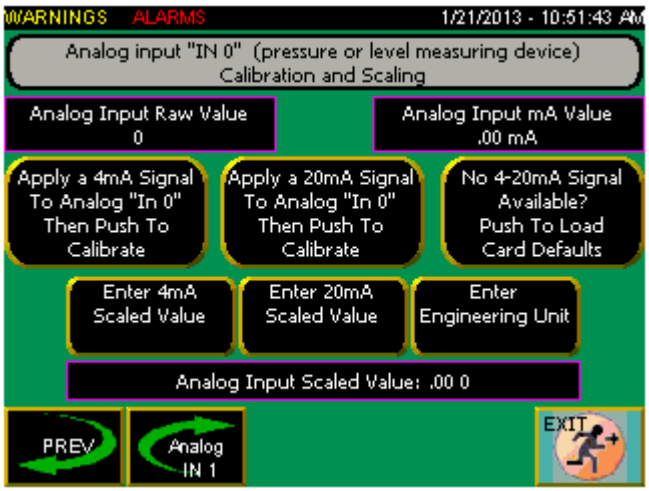
Example 3: The setup is as shown, however now the **Lag1** pump is not allowed to run in backup. Again, let's say that pump 2 is the lead pump. **Lead Start** float is activated. Pump 2 starts --- 60 sec. time delay --- and although pumps 1 and 3 are both set for lag1, they do no run because the lag1 pumps are not allowed to run due to the selection on the **Backup Pump Selection** screen --- 60 sec. time delay --- pump 4 (lag2) starts.

Configuring Analog Inputs

Now that the application has been set up, you can continue through the rest of the configuration.

1. From the Main screen, press **Analog Inputs Config** to display the configuration screen.

   This button is not visible unless an analog device is being used (**Measurement Setup** screen).


WARNINGS
ALARMS
1/21/2013 - 10:51:43 AM
Analog input "IN 0" (pressure or level measuring device) Calibration and Scaling
Analog Input Raw Value 0
Analog Input mA Value .00 mA
Apply a 4mA Signal To Analog "In 0" Then Push To Calibrate
Apply a 20mA Signal To Analog "In 0" Then Push To Calibrate
No 4-20mA Signal Available? Push To Load Card Defaults
Enter 4mA Scaled Value
Enter 20mA Scaled Value
Enter Engineering Unit
Analog Input Scaled Value: .00 0
PREV
Analog IN 1
EXIT

   The screen includes displays showing the raw data coming from the analog input card and mA value of the input from the calibrated (zero and span set) card.

2. Select one of the two following calibration methods:

– Apply a 4mA signal to the cards input (I:1.0), then push **Apply a 4mA Signal To Analog "In 0"** to make the zero adjustment. After making the zero adjustment, choose **Apply a 20mA Signal To Analog "In 0"** to make the span adjustment if a signal is available.
– Select **No 4-20mA Signal Available?** to calibrate the analog input using the card's default values if no current calibrator is available.

IMPORTANT

You must use one of these calibration methods to ensure proper operation.

3. Enter a scaled value in the **Enter 4mA Signal Value** field. For example: 0 Ft.

4. Enter a scaled value in the **Enter 20mA Signal Value** field. For example: 10 Ft.

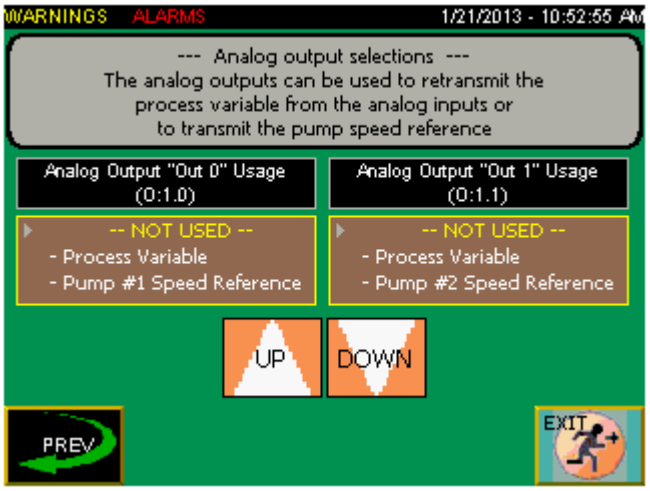
5. Enter a measurement unit type in the **Enter Engineering Unit** field. For example: Ft, Inch, PSI.

6. Once the scaled values have been entered, the scaled value of the analog input displays in the **Analog Input Scaled Value** area.

7. The second analog Input (I:1.1) is the same as input I:1.0. If the second analog input is not being used, it does not need to be set up.

Configuring Analog Outputs

1. From the Main screen, press **Analog Outputs Config** to display the configuration screen.


WARNINGS
ALARMS
1/21/2013 - 10:52:55 AM
--- Analog output selections ---
The analog outputs can be used to retransmit the process variable from the analog inputs or to transmit the pump speed reference
Analog Output "Out 0" Usage (O:1.0)
Analog Output "Out 1" Usage (O:1.1)
-- NOT USED --
- Process Variable
- Pump #1 Speed Reference
-- NOT USED --
- Process Variable
- Pump #2 Speed Reference
UP
DOWN
PREV
EXIT

2. Set the **Analog Output "Out 0" Usage (O:1.0)** to retransmit a 4-20mA signal from the process variable (the analog signal connected to one of the analog inputs) or to set the pump #1 VFD speed reference (4mA=0Hz, 20mA=60Hz).

3. Set the **Analog Output "Out 1" Usage (O:1.1)** to retransmit a 4-20mA signal from the process variable (the analog signal connected to one of the analog inputs) or to set the pump #2 VFD speed reference (4mA=0Hz, 20mA=60Hz).

TIP

Note: The process variable can be the signal from analog input I:1.0 or input I:1.1. The default process variable is I:1.0 but can be changed from the **Measuring Setup** screen under the **Analog Input "In 1" Usage** selection.

TIP

Note: In order for the analog output to transmit a VFD speed reference, the corresponding pump needs to have either **PowerFlex 4 series VFD** or **Other VFD** selected from the **Motor Control Setup** screen.

Setting the Process Configuration

1. From the Main screen, press **Process Config** to display the setup screen. The number of pumps shown may vary depending on how many pumps are in use.

2. From the setup screen you can:
   - Use the **UP/DOWN** buttons to select between **Hand**, **Off** and **Auto** for each configured pump.
   - Set a **Primary** selection for each pump. Select from **Alternate**, **Lead**, **Lag 1** and **Lag 2**.
   - Set a **Secondary** selection for each pump. Select from **Lag 1**, **Lag 2** and **Not Used**.

The secondary selections only come into use when the primary selection is set as **Alternate** and a second pump is required to run.

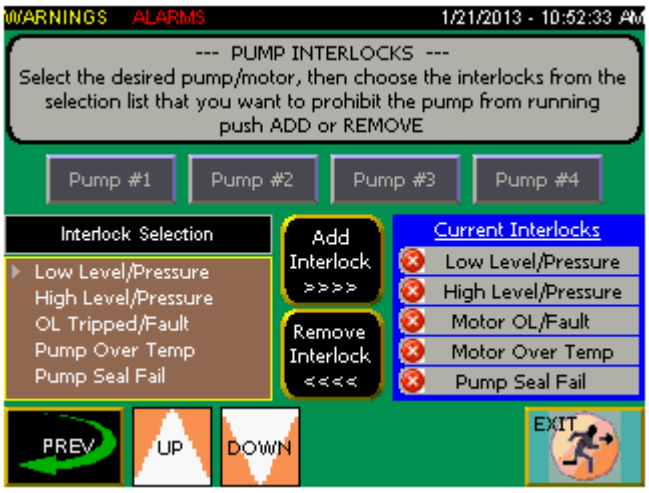
The following are three examples of sequencing:

1. Pumping sequence example #1: All pumps have “Alternate” selected as primary and are in “Auto”. When a pump is required to run, pump #1 starts and runs until the level is satisfied. The next time a pump is required to run, pump #2 starts; however the level gets to a point where one pump cannot keep up and a second pump is required. At that point all of the pumps with “Lag 1” selected as secondary will start. All pumps will continue to run until the level is satisfied.
2. Pumping sequence example #2: Same scenario as example #1 except pump #2 is “Off”. After pump #1 runs and then turns off. Pump #3 will run on the next cycle. Because even though pump #2 has “alternate” selected, it is turned “Off” and is therefore taken out of the alternation sequence.
3. Pumping sequence example #3: Pump #2 is set for “Lead”, pump #1 is set for “Lag 1” and pump #3 is set for “Lag2”. When the level requires a pump to run, pump #2 comes on and runs until the level is satisfied. If the level continues to change and requires another pump to run, pump #1 will start. If the level still continues to change and requires another pump, pump #3 will start. The pumps will continue to run until the stop level is satisfied. With all pumps now off, when the level requires a pump to come on, the sequence repeats itself, there is no alternation.

4. Access other setup screens as needed from the navigation at the bottom of the **Process Config** screen.
   - Press **Pump Interlocks** to open the Pump Interlocks screen. Refer to Pump Interlocks on page 246.
   - Press **Backup Pump Selection** to open the Backup Pump Selection screen. Visible only if **Float** is selected as backup on the **Measuring Setup** screen. Refer to page 240.
   - Press **Pressure Setpoints** to open the Pressure Setpoints screen Visible only if **Pressure follower** mode is selected. Refer to Pressure Setpoints on page 247.
   - Press **Level Setpoints** to open the Level Setpoints screen. Visible only if an analog device is being used for measuring level. Refer to Level Setpoints on page 247.

Pump Interlocks

You can use the Pump Interlocks screen to select from a list of faults that will inhibit the pump from running.



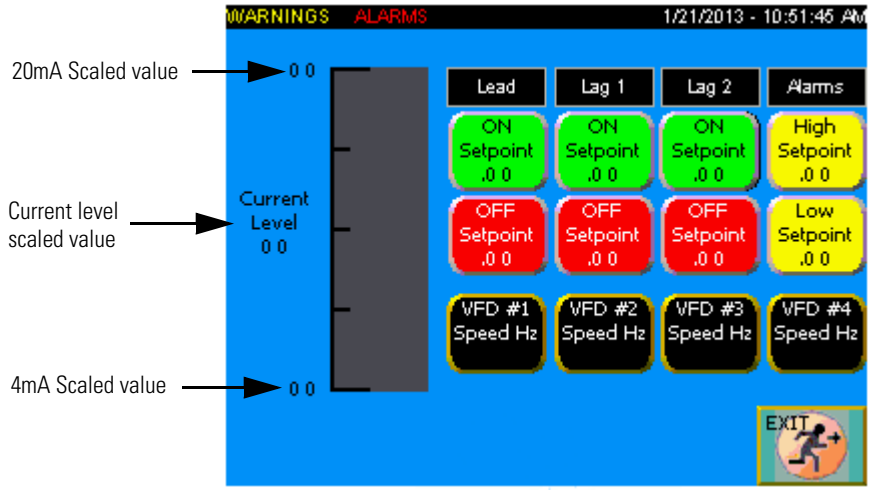
1. Select and perform the following steps for each pump individually.

2. Select the interlock from the list, and then use the **Add Interlock** button to add it to the Current Interlocks or use the **Remove Interlock** button to remove it from the Current Interlocks.

   For example: If **Pump Seal Fail** is in an alarm state, press **Remove Interlock** to allow the pump to continue running in that alarm state.

   A white X in a red circle indicates an interlock that has been removed, while a blue check mark in a gray box indicates an interlock that has been added.

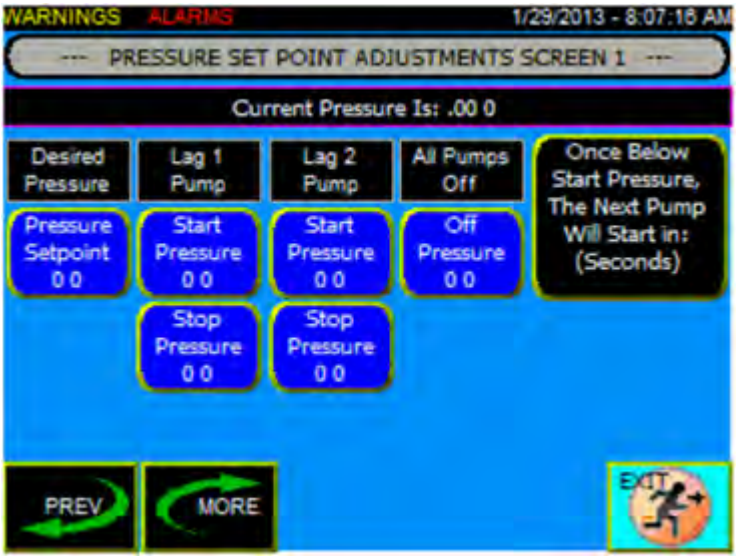
Level Setpoints



From the **Level Setpoints** screen you can:

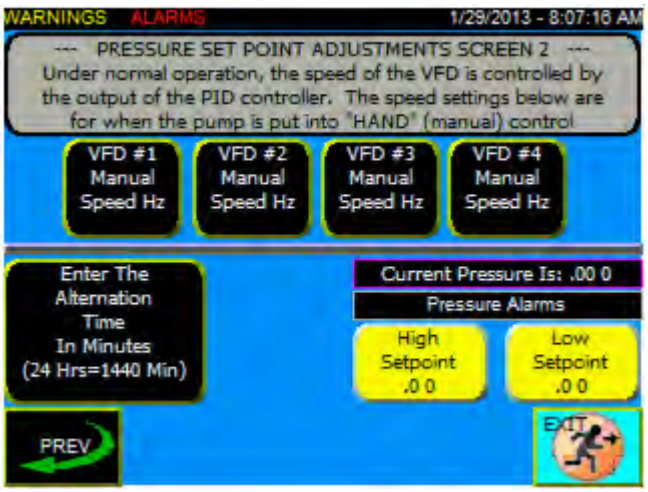
- Press **On Setpoint** to enter the level at which you want the selected pump to turn on.
- Press **Off Setpoint** to enter the level at which you want the selected pump to turn off.
- Press **VFD # Speed Hz** to enter the desired VFD speed (in Hz) when running in **Level** mode. The **VFD # Speed Hz** button is not visible if **Starters** were selected on the **Motor Control Setup** screen.
- Press the **High** and **Low Alarm Setpoints** to enter the threshold values for triggering the related alarms.

Pressure Setpoints



From the first **Pressure Setpoints** screen you can:

– Press **Pressure Setpoint** to enter the desired system pressure.
– Press **Start Pressure** to set the pressure (combined with the time delay) at which the Lag 1 and Lag 2 pumps will come on if the desired pressure is unable to be maintained.
– View the current pressure reading (analog input must have been set up previously).
– Press **Once Below Start Pressure The Next Pump Will Start in: (Seconds)** to enter the time delay in seconds between Lag pump starts. If system pressure falls below the start set point, the Lag pump starting is delayed by this value.
– Press **Off Pressure** to set the system pressure point at which all of the pumps shut off.
– Press **More** to see the second **Pressure Setpoints** screen.


WARNINGS
ALARMS
1/29/2013 - 8:07:16 AM
--- PRESSURE SET POINT ADJUSTMENTS SCREEN 2 ---
Under normal operation, the speed of the VFD is controlled by the output of the PID controller. The speed settings below are for when the pump is put into "HAND" (manual) control
VFD #1 Manual Speed Hz
VFD #2 Manual Speed Hz
VFD #3 Manual Speed Hz
VFD #4 Manual Speed Hz
Enter The Alternation Time In Minutes (24 Hrs=1440 Min)
Current Pressure Is: .00 0
Pressure Alarms
High Setpoint .0 0
Low Setpoint .0 0
PREV
EXIT

– Press **VFD # Manual Speed Hz** to set the speed at which the drive will run when placed into Manual.
– Press **Enter The Alternation Time In Minutes** to set the time between pump alternations. This is only used if the **Primary** selection is set to **Alternation** on the **Process Configuration** screen.

TIP

Lead pump alternation will only occur if the lead pump is the only pump running. If the alternation time has elapsed during high demand when more pumps are running, the alternation will happen only when all pumps other than the lead pump have turn off.

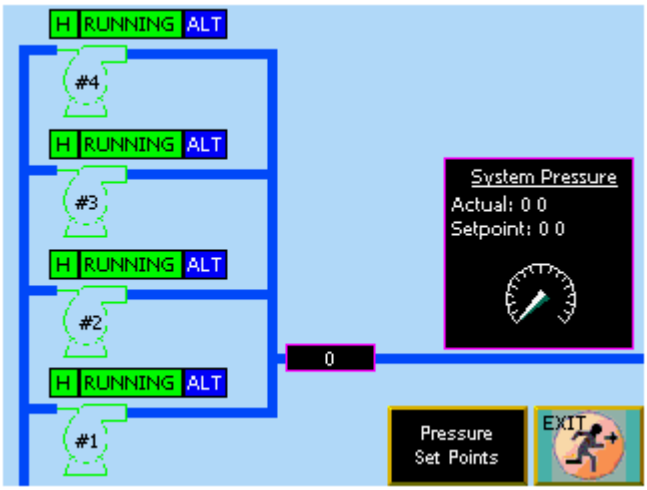
– Press **High Setpoint** to set the high pressure alarm threshold.

TIP

The **High Pressure** alarm set point is not the same as the **All Pumps Off** set point on the **Pressure Set point 1** screen. The **All Pumps Off** set point is meant to turn the pumps off before it goes into **High Pressure** alarm.

– Press **Low Setpoint** to set the low pressure alarm threshold.

Pressure Overview Screen

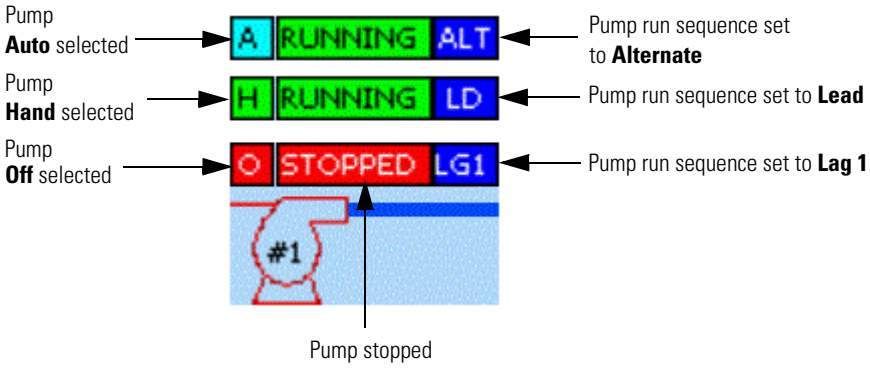


From the **Pressure Overview** screen you can:

– View the current system pressure and set point

– View the flow rate readout, if **Analog Input In 1** is assigned to **Flow** on the Measuring Setup screen, or if **Digital Input 0 (I:0/0)** on the **Digital Inputs Assign 1** screen is set for **Use For Pulse Counter**

– View pump status, mode and sequence information, as shown below

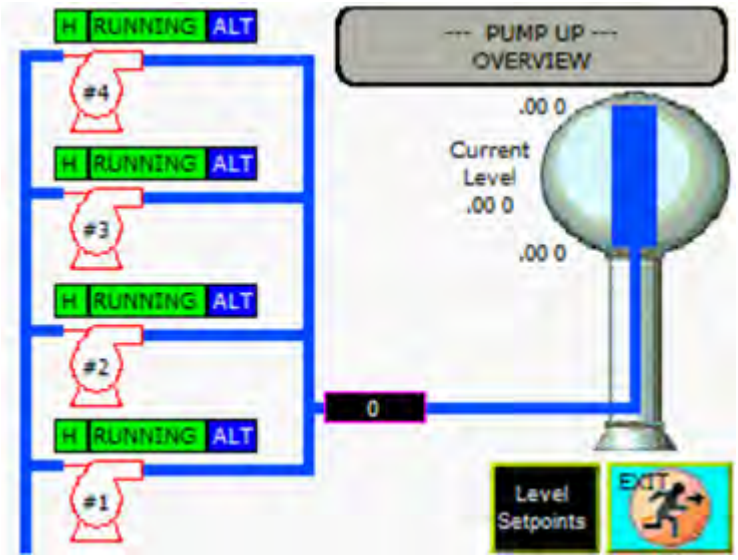


Pump Down Overview Screen

From the **Pump Down Overview** screen you can:

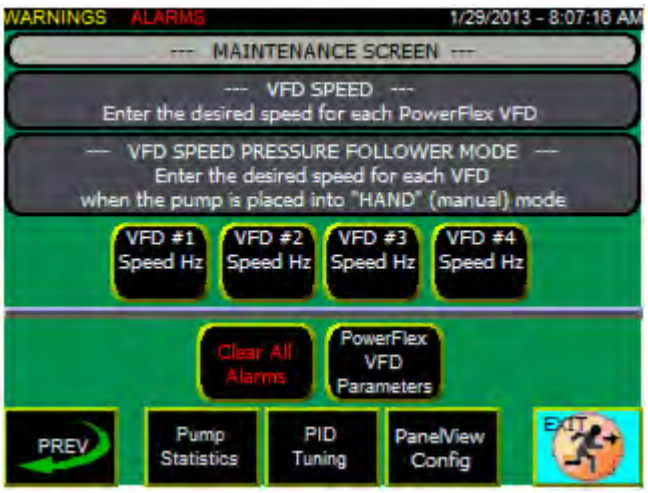
- View the 20mA scaled value
- View the current level scaled value
- View the 4mA scaled value
- View pump status, mode and sequence information, as on the Pressure Overview screen.

Pump Up Overview Screen



From the **Pump Up Overview** screen you can view pump status, mode, sequence and level information.

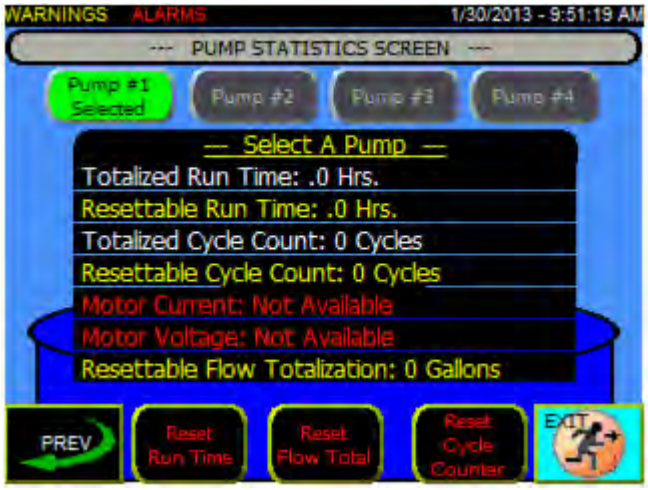
Maintenance Screen



From the **Maintenance** screen you can:

- Press **Clear All Alarms** to clear all of the alarms from the alarm history. Refer to Alarms Screen on page 258.
- Press **VFD # Speed Hz** to enter the desired speed for each VFD. The **VFD # Speed Hz** button is visible only if **PowerFlex 4 VFD** or **Other VFD** is selected in the **Motor Control Setup** screen.
- Press **PowerFlex VFD Parameters** to open the PowerFlex 4 VFD Parameters screen. Refer to PowerFlex 4 VFD Parameters on page 253. The **PowerFlex VFD Parameters** button is visible only if **PowerFlex 4 VFD** is being used.
- Press **Pump Statistics** to open the Pump Statistics screen. Refer to Pump Statistics Screen on page 252. The **Pump Statistics** button is only visible after an application has been assigned
- Press **PID Tuning** to access the PD Tuning screen. Refer to PID Tuning Screen on page 252. The **PID Tuning** button is visible only if **Pressure Follower** mode is selected
- Press **PanelView Config** to close the running PanelView application and open the PanelView configuration screen

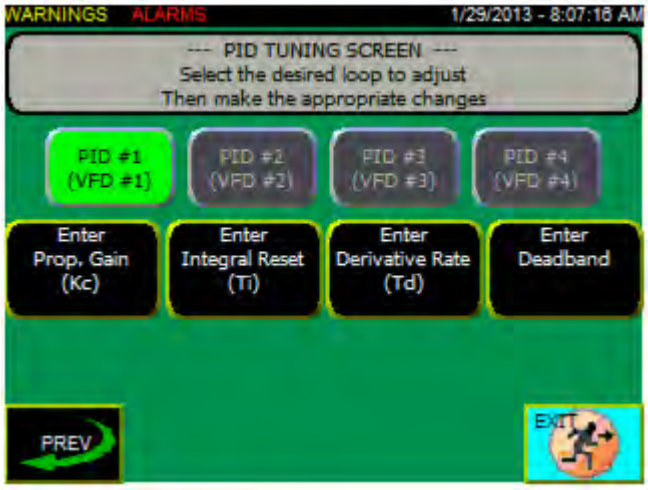
Pump Statistics Screen



From the **Pump Statistics** screen you can:

- Select a pump to view the statistics for that pump. The number of pumps visible depends on how many are in use. The flow totalization is only visible if digital input I:0/0 is set to totalize or if analog input I:1.1 is set for flow
- Reset the run time and cycle count (shown in yellow)
- View the motor current and voltage if a PowerFlex series 4 VFD is in use
- View the flow totalization, if digital input I:0/0 is set to totalize or if analog input I:1.1 is set for flow

PID Tuning Screen



From the **PID Tuning** screen you can:

- Select a pump to view or change the PID values for that pump. The number of pumps visible depend on how many are in use.
- Press **Enter Prop. Gain (Kc)** to enter the gain value for the PID.
- Press **Enter Integral Reset (Ti) to e**nter the reset value for the PID.
- Press **Enter Derivative Rate (Td)** to enter the rate value for the PID.
- Press **Enter Deadband** to enter the deadband value for the PID.

PowerFlex 4 VFD Parameters

From the **PowerFlex 4 VFD Parameters** screen you can:

- Save PowerFlex 4 series VFD parameters from the VFD to a database in the PLC
- Load saved PowerFlex 4 series VFD parameters from a database into the VFD

If a PowerFlex 4 series VFD is being used, you can save different sets of parameters under different recipe names. If you save the parameters to an existing database recipe, the previous recipe will be overwritten.

WARNINGS ALARMS
1/29/2013 - 8:07:16 AM
--- POWER FLEX VFD PARAMETER OPTIONS SCREEN ---
Once the parameters on the VFD are setup the way you want, you can save the parameters to a database that resides in the PLC. They can then be loaded into the VFD later.
Save PowerFlex 4 VFD Parameters Into Database
Load PowerFlex 4 Parameters From Database Into VFD
PREV
EXIT

To save a recipe:

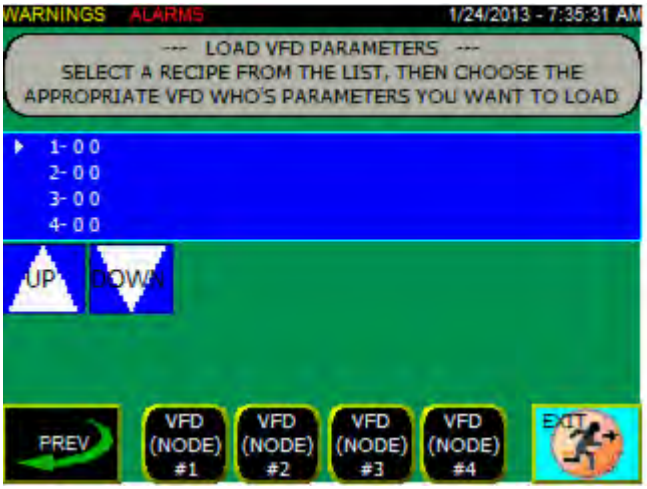
1. From the PowerFlex 4 VFD Parameters screen, press **Save PowerFlex 4 VFD Parameters Into Database** to open the **Save VFD Parameters** screen..

2. From the **Save VFD Parameters** screen you can:
   - Use the **UP/DOWN** buttons to select a database recipe from the list
   - Press **RENAME RECIPE** to give the selected recipe a descriptive name
   - Press **ACCEPT** or **CANCEL NEW NAME** to confirm or discard the naming of the recipe.
   - View the new recipe name, if a recipe name is being changed
   - Press **CLEAR THE SAVED RECIPE** to clear the selected database recipe.

3. Once the desired recipe is selected from the list, press **VFD (NODE)** # to select the VFD using the parameters you want to save. This option is visible only if a PowerFlex VFD is found at the appropriate node.

To load a recipe:

1. From the PowerFlex 4 VFD Parameters screen, press **Load PowerFlex 4 VFD Parameters From Database Into VFD** to open the **Load VFD Parameters** screen.



2. Press **UP/DOWN** to select a database recipe from the list.

3. Press **VFD (NODE) #** to select the VFD into which you wish to load the selected recipe. This option is visible only if a PowerFlex VFD is found at the appropriate node.

   Not all of the parameters are loaded into the VFD. The Modbus node address, comm speed and comm formate will not overwrite what is already set in the VFD. This way the VFD parameters from node #1 can be written into the VFD at node #2.

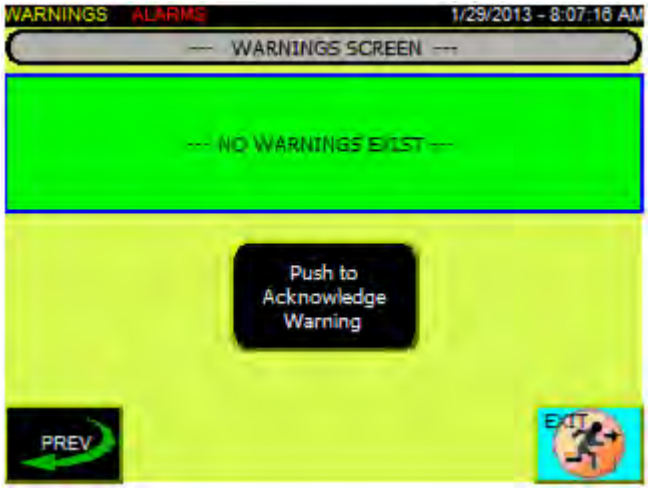
TIP

If the system has a combination of different PowerFlex 4 VFD's, such as one PowerFlex 4 and one PowerFlex 40. Care needs to be taken to ensure that the parameters of a PF 4 VFD do not get loaded into a PF 40 VFD.

TIP

After the parameters are loaded into the VFD. The VFD needs to have the power cycled in order for the new parameters to take effect.

Warning Screen



From the **Warning** screen you can:

- View the current warning message.
- Press **Push to Acknowledge Warning** to scroll through each active warning if multiple warnings exist.

TIP

Although some of the warnings can be alarms, they are typically settings or setup issues that have conflicts.

List of available warnings:

-- NO WARNINGS EXIST ---	--- PRIMARY MEASURING IS SET FOR FLOATS --- --- AND THE MODE IS SET FOR "EMPTY (PUMP DOWN)" --- A PUMP IS ASSIGNED TO "LAG2" AN INPUT NEEDS TO BE ASSIGNED TO "HIGH LEVEL" OR THE PUMP NEEDS TO BE IN "OFF"
--- PRIMARY MEASURING IS SET FOR FLOATS --- AN INPUT NEEDS TO BE ASSIGNED TO "PUMPS STOP" AND AN INPUT NEEDS TO BE ASSIGNED TO "LEAD START	--- PRIMARY MEASURING IS SET FOR FLOATS --- --- AND THE MODE IS SET FOR "FILL (PUMP UP)" --- A PUMP IS ASSIGNED TO "LAG2" AN INPUT NEEDS TO BE ASSIGNED TO "LOW LEVEL" OR THE PUMP NEEDS TO BE IN "OFF"
--- SECONDARY (BACKUP) MEASURING IS SET FOR FLOATS --- AN INPUT NEEDS TO BE ASSIGNED TO "PUMPS STOP" AND AN INPUT NEEDS TO BE ASSIGNED TO "LEAD START	--- SECONDARY (BACKUP) MEASURING IS SET FOR FLOATS --- AT LEAST ONE PUMP NEEDS TO BE SELECTED TO RUN AS BACKUP

THE "HAND-OFF-AUTO" SELECTORS FOR ALL PUMPS, IS SET TO "OFF"	-- PUMP #1 -- HAS ITS OVERLOAD TRIPPED/VFD FAULT INTERLOCK ENABLED AN INPUT NEEDS TO BE ASSIGNED TO "OL TRIPPED/VFD FAULT" OR THE INTERLOCK NEEDS TO BE DISABLED
--- PRESSURE MODE SELECTED --- AND A "STOP PRESSURE" SET POINT IS SET LOWER THEN A "START PRESSURE" SET POINT	-- PUMP #1 -- HAS ITS OVER TEMP INTERLOCK ENABLED AN INPUT NEEDS TO BE ASSIGNED TO "OVER TEMP" OR THE INTERLOCK NEEDS TO BE DISABLED
--- PUMP DOWN MODE SELECTED --- THE PUMP STOP LEVELS NEED TO BE SET LOWERTHENTHE PUMP START LEVELS	-- PUMP #1 -- HAS ITS SEAL FAIL INTERLOCK ENABLED AN INPUT NEEDS TO BE ASSIGNED TO "SEAL FAIL" OR THE INTERLOCK NEEDS TO BE DISABLED
--- PUMP UP MODE SELECTED --- THE PUMP STOP LEVELS NEED TO BE SET HIGHER THEN THE PUMP START LEVELS	-- PUMP #2 -- HAS ITS OVERLOAD TRIPPED/VFD FAULT INTERLOCK ENABLED AN INPUT NEEDS TO BE ASSIGNED TO "OL TRIPPED/VFD FAULT" OR THE INTERLOCK NEEDS TO BE DISABLED
--- PRESSURE MODE SELECTED --- AND THE "STOP PUMPS" SET POINT IS SET LOWER THEN THE "DESIRED PRESSURE" SET POINT	-- PUMP #2 -- HAS ITS OVER TEMP INTERLOCK ENABLED AN INPUT NEEDS TO BE ASSIGNED TO "OVER TEMP" OR THE INTERLOCK NEEDS TO BE DISABLED
--- PRIMARY MEASURING IS SET FOR FLOATS --- A PUMP IS ASSIGNED TO "LAG1" AN INPUT NEEDS TO BE ASSIGNED TO "LAG START" OR THE PUMP NEEDS TO BE IN "OFF"	-- PUMP #2 -- HAS ITS SEAL FAIL INTERLOCK ENABLED AN INPUT NEEDS TO BE ASSIGNED TO "SEAL FAIL" OR THE INTERLOCK NEEDS TO BE DISABLED
-- PUMP #3 -- HAS ITS OVERLOAD TRIPPED/VFD FAULT INTERLOCK ENABLED AN INPUT NEEDS TO BE ASSIGNED TO "OL TRIPPED/VFD FAULT" OR THE INTERLOCK NEEDS TO BE DISABLED	
-- PUMP #3 -- HAS ITS OVER TEMP INTERLOCK ENABLED AN INPUT NEEDS TO BE ASSIGNED TO "OVER TEMP" OR THE INTERLOCK NEEDS TO BE DISABLED	

-- PUMP #3 -- HAS ITS SEAL FAIL INTERLOCK ENABLED AN INPUT NEEDS TO BE ASSIGNED TO "SEAL FAIL" OR THE INTERLOCK NEEDS TO BE DISABLED	
-- PUMP #4 -- HAS ITS OVERLOAD TRIPPED/VFD FAULT INTERLOCK ENABLED AN INPUT NEEDS TO BE ASSIGNED TO "OL TRIPPED/VFD FAULT" OR THE INTERLOCK NEEDS TO BE DISABLED	
-- PUMP #4 -- HAS ITS OVER TEMP INTERLOCK ENABLED AN INPUT NEEDS TO BE ASSIGNED TO "OVER TEMP" OR THE INTERLOCK NEEDS TO BE DISABLED	
-- PUMP #4 -- HAS ITS SEAL FAIL INTERLOCK ENABLED AN INPUT NEEDS TO BE ASSIGNED TO "SEAL FAIL" OR THE INTERLOCK NEEDS TO BE DISABLED	
-- PRESSURE MODE -- ALL PUMPS TURNED OFF DUE TO HIGH PRESSURE	

Alarms Screen

From the **Alarms** screen you can view a list of active and/or inactive alarms. Active alarms are shown in white against a red background, and inactive alarms are shown in blue against a white background. The newest alarms

appear at the top of the list. Alarms remain in the list until the **Clear All Alarms** button is pushed on the maintenance screen.

Because this list contains past alarms (history), use the **UP/DOWN** and **PAGE UP/PAGE DOWN** buttons to scroll through the list.

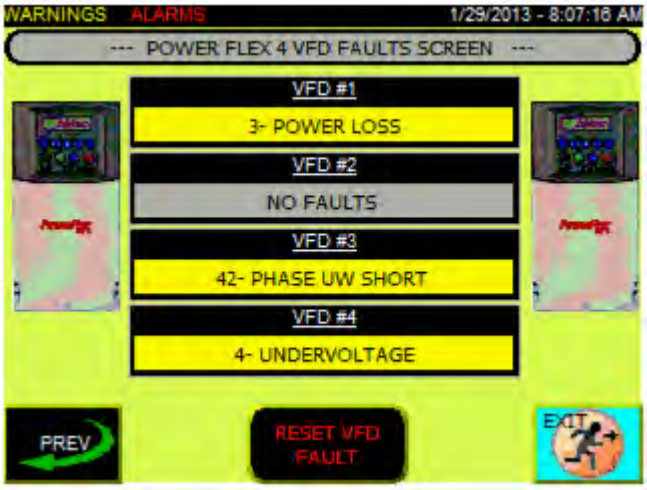
From this screen you can also:

- Press **View Warnings** to go to the Warning screen. Refer to Warning Screen on page 256.
- Press **Alarm Output Config** to go to the **Alarm Output Configuration** screen. Refer to Alarm Output Configuration on page 261.
- Press **View VFD Alarms** to view PowerFlex 4 alarms, if a PowerFlex 4 VFD is being used. Refer to VFD Faults (PowerFlex 4 VFDs only) on page 260.

List of available alarms:

System Interlock I:0/19 Not Energized	Pump #2 Failed To Run
High Level	PowerFlex VFD #2 Comm Loss
Low Level	Pump #2 OL Tripped/VFD Fault
High Pressure	Pump #2 Over Temp
Low Pressure	Pump #2 Seal Fail
Analog Input I:1.0 Out Of Range	Pump #3 Failed To Run
Analog Input I:1.1 Out Of Range	PowerFlex VFD #3 Comm Loss
Power Failure	Pump #3 OL Tripped/VFD Fault
Generator Running	Pump #3 Over Temp
Generator Fault	Pump #3 Seal Fail
General Fault	Pump #4 Failed To Run
Pump #1 Failed To Run	PowerFlex VFD #4 Comm Loss
PowerFlex VFD #1 Comm Loss	Pump #4 OL Tripped/VFD Fault
Pump #1 OL Tripped/VFD Fault	Pump #4 Over Temp
Pump #1 Over Temp	Pump #4 Seal Fail
Pump #1 Seal Fail	

VFD Faults (PowerFlex 4 VFDs only)

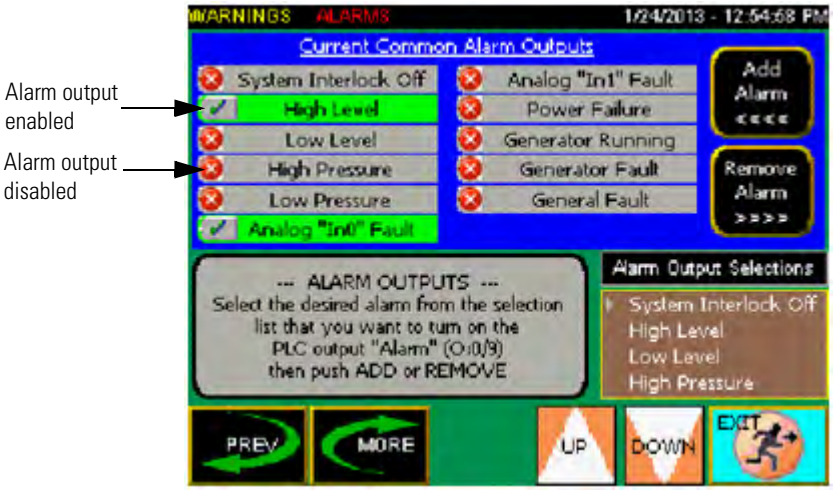


The **VFD Faults** screen shows faults for each PowerFlex 4 VFD in use (in this example four VFDs are in use). The fault information comes from the PowerFlex 4 VFD via the Modbus communication. Press **RESET VFD FAULT** or the stop button on the VFD to reset the VFD fault.

List of available PowerFlex VFD faults:

NO FAULTS	39- PHASE V TO GROUND SHORT
2- AUXILIARY INPUT	40- PHASE W TO GROUND SHORT
3- POWER LOSS	41- PHASE UV SHORT
4- UNDERVOLTAGE	42- PHASE UW SHORT
5- OVERVOLTAGE	43- PHASE VW SHORT
6- MOTOR STALLED	63- SOFTWARE OVERCURRENT
7- MOTOR OVERLOAD	64- DRIVE OVERLOAD
8- HEATSINK OVERTEMPERATURE	70- POWER UNIT FAILED
12- HW OVERCURRENT (300%)	80- AUTO TUNE FAILED
13- GROUND FAULT	81- COMMUNICATION LOSS
29- ANALOG INPUT LOSS	100- PARAMETER CHECKSUM ERROR
33- AUTO RESTART TRIES	122- I/O BOARD FAIL
38- PHASE U TO GROUND SHORT	

Alarm Output Configuration



From the **Alarm Output Configuration** screen you can:

– Press **UP/DOWN** to select a process-specific alarm from the list

– Press **Add Alarm** or **Remove Alarm** to enable or disable the selected process-specific alarm

The alarms, when enabled, combine to turn on PLC output O:0/9. If the alarm is not enabled, even though it becomes active, it will not turn the PLC output on.

– Press **MORE** to add pump-specific alarms from the **Pump # Alarm Output Configuration** screen(s). Refer to Pump #1 Alarm Output Configuration on page 261.

Pump #1 Alarm Output Configuration

WARNINGS ALARMS
1/24/2013 - 1:01:28 PM
Current Pump #1 Alarm Outputs
Pump Failed To Run
PowerFlex VFD Comm Loss
Pump OL Tripped/VFD Fault
Pump Over Temp
Pump Seal Fail
Add Alarm <<<<
Remove Alarm >>>>
-- ALARM OUTPUTS --
Select the desired alarm from the selection list that you want to turn on the PLC output "Alarm" (O:0/9) then push ADD or REMOVE
Alarm Output Selections
Pump #1 Failed To Run
PowerFlex VFD #1 Comm Loss
Pump #1 OL Tripped/VFD Fault
Pump #1 Over Temp
Pump #1 Seal Fail
PREV
MORE
UP
DOWN
EXIT

Refer to Alarm Output Configuration on page 261 for screen descriptions and functions. Add and/or remove alarms for the selected pump. Press **MORE** to

add or remove alarms on additional pumps, if any. The alarm output screens for pumps #2-4 are the same as pump #1.

PowerFlex 4 series VFD set up (must have firmware version 6.0 or higher)

If PowerFlex 4 VFD's are being used, the following parameters need to be set on each VFD.

1. P36 (start source) = 5 (comm port)

2. P38 (speed reference) =5 (comm port)

3. PowerFlex 4/40 - A103 (comm data rate) = 5 (38.4k), PowerFlex 400 - C103 (comm data rate) = 5 (38.4k)

4. PowerFlex 4/40 - A104 (comm node address) = 1-4, PowerFlex 400 - C104 (comm node address) = 1-4

   The PLC is programed to control PowerFlex 4 VFD's at node address 1-4. If pump #1 is a PowerFlex 4 drive, it **must** be set to node "1". If pump #2 is a PowerFlex 4 drive, it **must** be set to node "2", and so on with the remaining pumps.

5. PowerFlex 4/40 - A106 (comm loss time) = 10 sec., PowerFlex 400 - C106 (comm loss time) = 10 sec.

   The default time of 5 sec. may work satisfactory, however during parameter saving and loading, the message instructions in the PLC may take longer than usual, and the additional time may alleviate some nuisance communication faults.

6. PowerFlex 4/40 - A107 (comm format) = 0 (RTU 8-N-1), PowerFlex 400 – C102 (comm format) = 0 (RTU 8-N-1)

Panel View C600 (2711C-T6T), Firmware version 1.60

1. IP address: 192.168.1.3

2. Subnet: 255.255.255.0

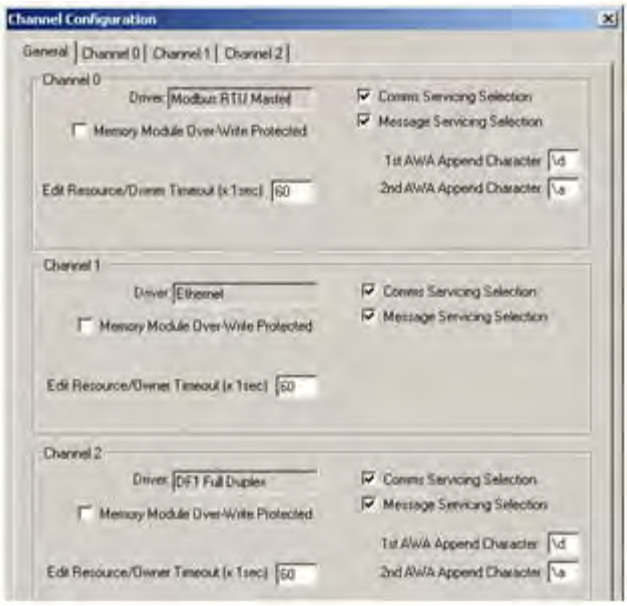
3. Gateway: 0.0.0.0 (not used)

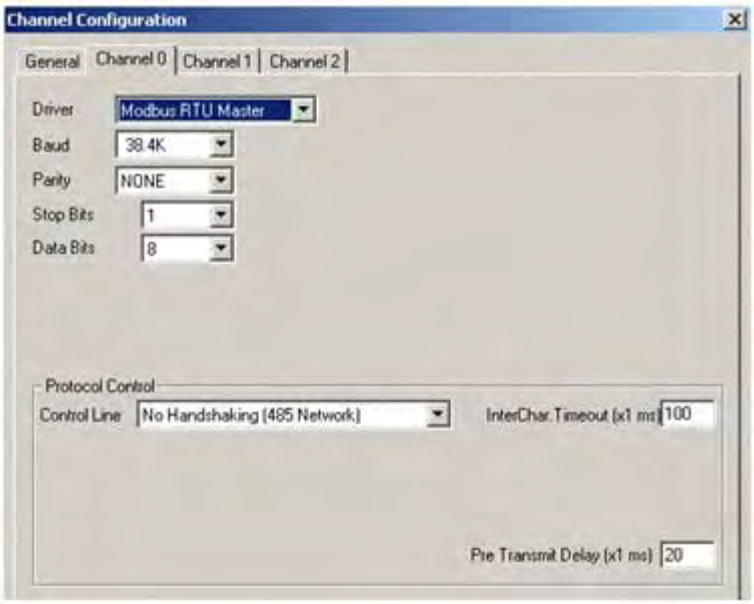
4. DHCP: Off (not used)

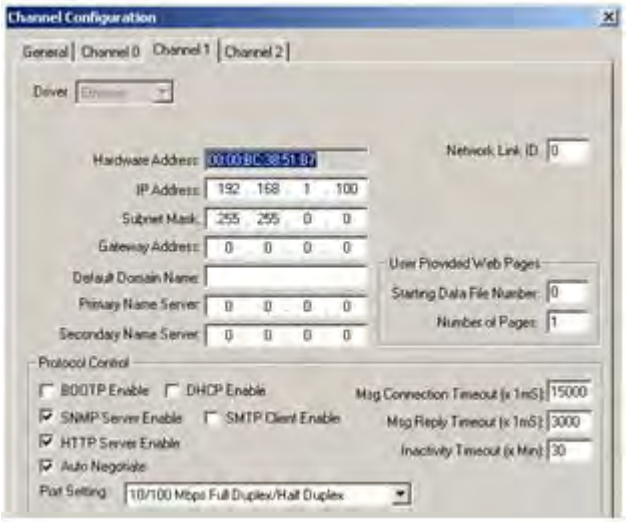
PLC Micro 1400 series A (1766-L32BXB)

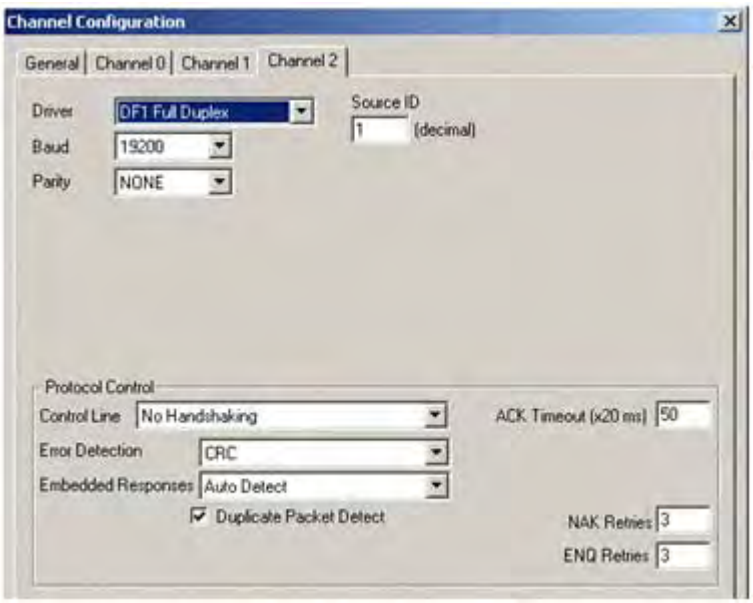
1. Analog I/O module 1762-IF2OF2, 2 chnl. Input, 2 chnl. Output

2. Channel settings.







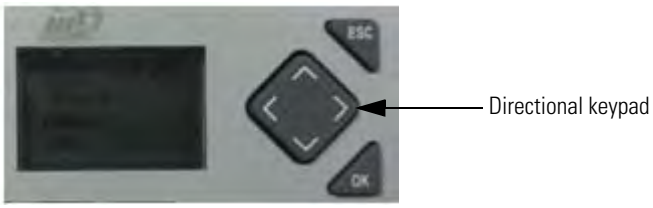


MicroLogix Memory Module.

The Multifunction Pump Control PLC program comes stored on a 1766-MM1 memory module.

To load the program from the memory module into the PLC:

1. Use the up/down buttons on the directional keypad to scroll to the **Advanced Set** option on the LCD display and push **OK**.



2. Scroll down to **Comms EEPROM** and push **OK**.
3. Scroll to **Load from MM** and push **OK**.
4. The **Run** LED will flash on/off. When loading is complete the **Run** LED will stay off. Push **OK**. To place the PLC into Run, push the **ESC** button several times until the display no longer changes. This will bring you out to the main menu.
5. Scroll down to **Mode Switch** and push **OK**.
6. Scroll down to **Run** and push **OK**. The PLC **Run** LED will turn on.

To save the program from the PLC into the memory module:

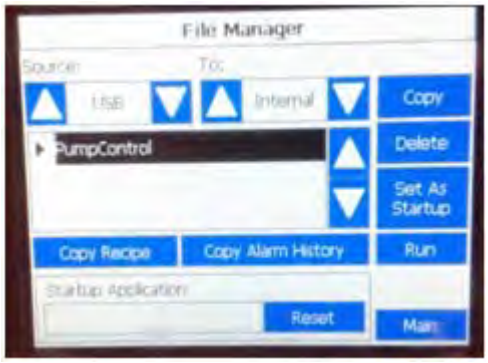
1. Use the up/down keypad to scroll to the **Advanced Set** option on the LCD display and push **OK**.
2. Scroll down to **Comms EEPROM** and push **OK**.
3. Scroll to **Store to MM** and push **OK**. The PLC will be taken out of **Run**.
4. On the next screen choose option 1 (Reuse Device). Do not choose option 2. If you choose option 2 (Write Only) you will only be able to write to the memory module one time and will not be able to save any more programs to it. Push **OK**.
5. The **Run** LED flashes on/off. When loading is complete the **Run** LED stays off.
6. Use the above procedure to put PLC back into **Run**.

PanelView component program load

On initial power up, the PanelView main menu displays.

1. Push **File Manager**.

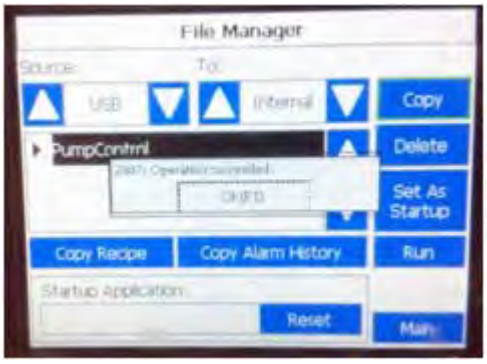
2. Use the **Up**/**Down** buttons to scroll to **USB** from the **Source** list.



3. Use the **Up**/**Down** buttons to scroll to **Internal** from the **To** list.
4. Push **Copy** to transfer the application from the USB storage into PanelView.

   The message **Operation Succeeded** displays.

5. Press **OK** to clear the pop-up window.



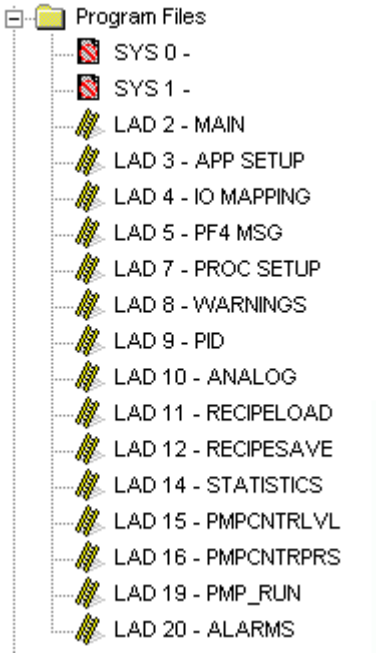
6. From the **Source** list select **Internal**.
7. Once the source is set to Internal, push **Set As Startup**.

The application name displays under **Startup Application**.

8. Push **Run** to launch the application.

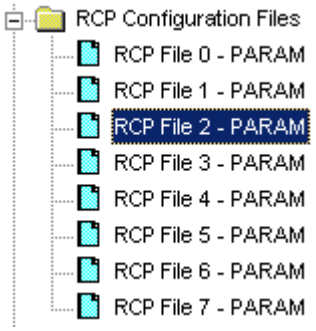
PLC Program Files

The PLC code is separated into separate program files. Each file contains the logic associated with certain operations. The **Main** file contains all of the jump to subroutine (JSR) instructions that scans all of the other files (3-20) sequentially.


Program Files
SYS 0 -
SYS 1 -
LAD 2 - MAIN
LAD 3 - APP SETUP
LAD 4 - IO MAPPING
LAD 5 - PF4 MSG
LAD 7 - PROC SETUP
LAD 8 - WARNINGS
LAD 9 - PID
LAD 10 - ANALOG
LAD 11 - RECIPELOAD
LAD 12 - RECIPESAVE
LAD 14 - STATISTICS
LAD 15 - PMPCNTRLVL
LAD 16 - PMPCNTRPRS
LAD 19 - PMP_RUN
LAD 20 - ALARMS

Recipe Files

The parameters for the PowerFlex 4 series VFD's are saved/recalled into/from RCP files. Because a RCP file has a max. file length of 32, there are 7 files required to hold all of the parameters.


RCP Configuration Files
RCP File 0 - PARAM
RCP File 1 - PARAM
RCP File 2 - PARAM
RCP File 3 - PARAM
RCP File 4 - PARAM
RCP File 5 - PARAM
RCP File 6 - PARAM
RCP File 7 - PARAM

Notes:

Installation and Commissioning

Installation and Commissioning

This chapter contains valuable resources to help you install and begin using the Water and Wastewater system. Use the following table to locate these resources.

To Access	See
Website resources for additional information, including: • Rockwell Automation product and knowledge base websites • Water and Wastewater industry websites	Website Resources on page 319
Related documentation to help you install/commission the Water and Wastewater system. This chapter lists the necessary user and quick start guides required to install/bring your system online.	Documentation Resources on page 320

Important Installation and Commissioning Drawings

Refer to the system architectural drawings for I/O check-out and system troubleshooting during installation and commissioning. These drawings reside on the Water and Wastewater Accelerator Toolkit CD. See the Introduction section in the Preface for more information.

Water and Wastewater Treatment Plant Hardware Drawings

The Water and Wastewater Treatment Plant (WWTP) Hardware documentation package contains the following system-level drawing packages:

- Lift Station System
- Dosing Pump Station System
- Primary Treatment System
- Headworks System
- Secondary Treatment System
- Solids Handling System
- Chemical Feed System
- Flushing System

The Lift Station and Dosing Pump Station drawings are included in this section for reference. These are typical of the others- all can be found on the WWWAT CD (Publication IASIMP-SP012). You can also go to the Rockwell Automation Integrated Architecture Tools Website, http://www.ab.com/go/iatools and download the drawings.

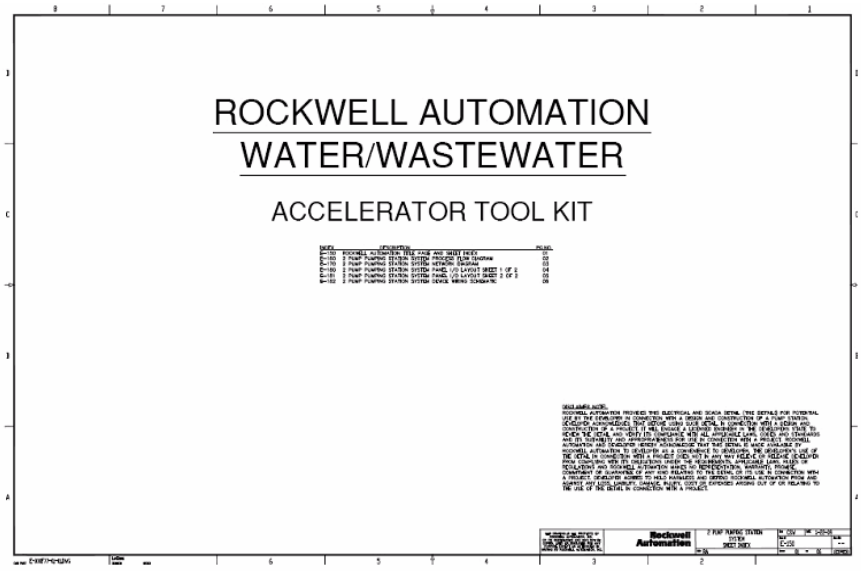
Lift Station Hardware Drawings

One of the System Architecture sub-folders on the WWWAT CD is the Lift Station folder and it contains the following drawings:

- Title Page and Sheet Index
- Process Flow Diagram
- Network Diagram
- Panel I/O Sheets
- Device Wiring Schematics

Title Page and Sheet Index

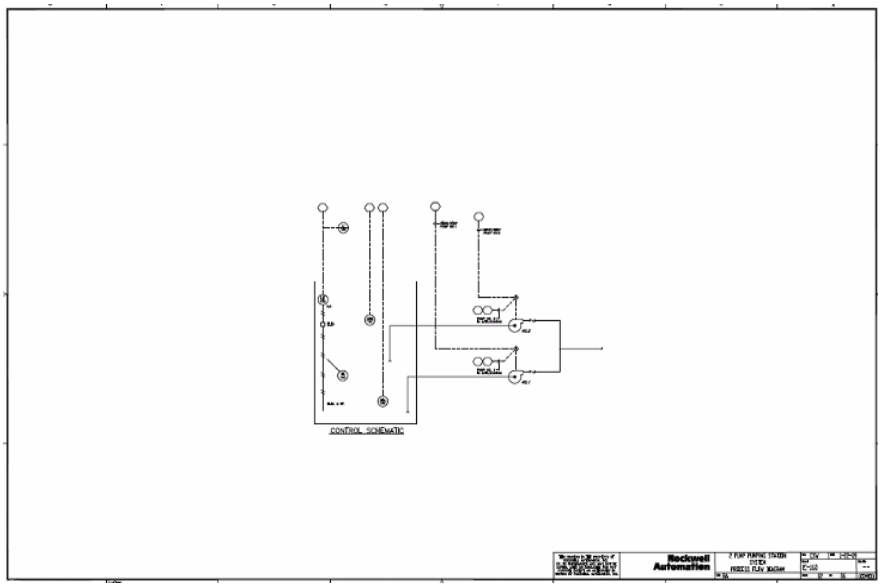
Lift Station Title Page and Sheet Index



Number	Title	Description
E-150	Title Page and Sheet Index	This is the Table of Contents/Cover Sheet for the drawing package. Modify this sheet as necessary to match the contents of the drawing package for your application.

Process Flow Diagram

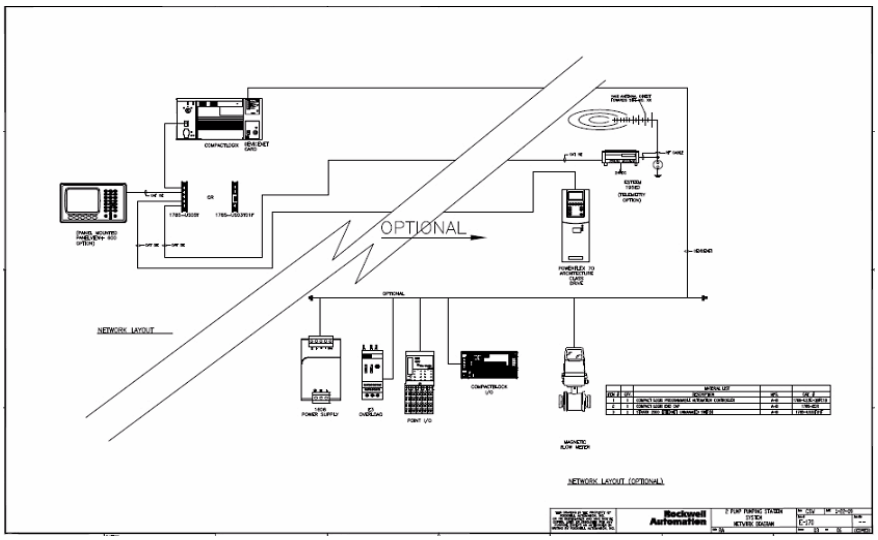
Lift Station System Process Flow Diagram



Number	Title	Description
E-160	System Process Flow Diagram	The Lift Station Process Flow diagram depicts a Lift Station consisting of two pumps with particular I/O. It provides a general overview of the process controlled by the system, a quick summary of the controls involved, and the process that is being controlled.

Network Diagram

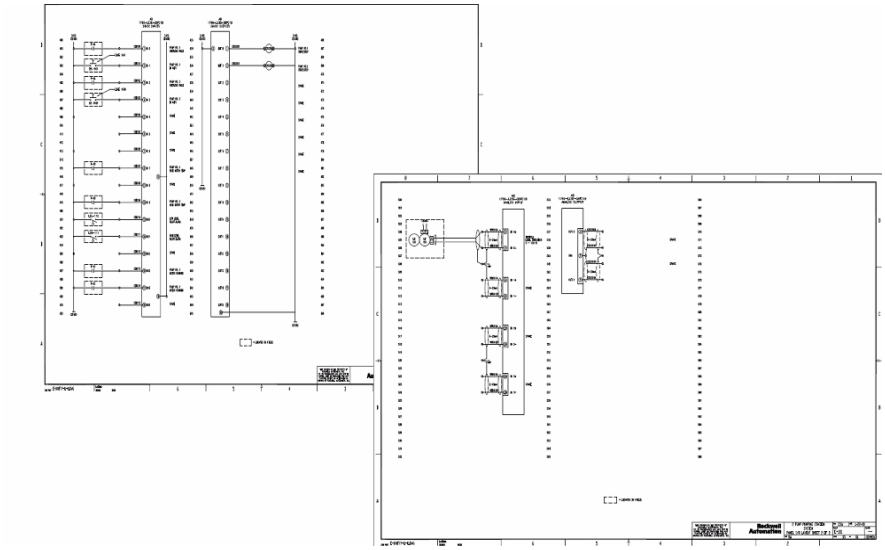
Lift Station Network Diagram



Number	Title	Description
E-170	Network Diagram	For details, see page 12.

Panel I/O Sheets

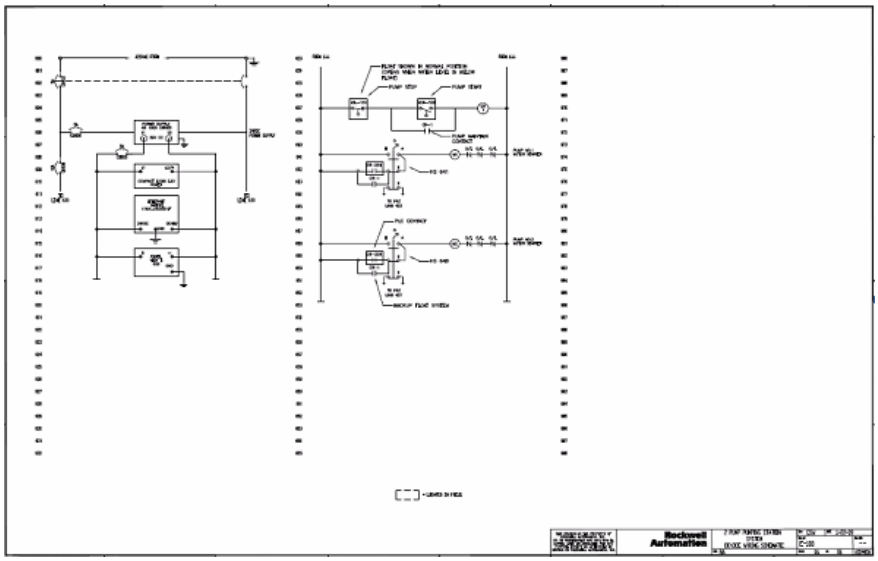
Lift Station Panel I/O Sheets



Number	Title	Description
E-180 E-181	Panel I/O Layout (Sheet 1 of 2) Panel I/O Layout (Sheet 2 of 2)	The Lift Station Inputs and outputs to the controller are shown on these diagrams. The format uses three cards per sheet. Inputs to the card are shown with the input device to the left of the input card. Output devices are shown to the right of the output card. For every additional input or output card, new sheets must be added. Refer to these sheets during the Commissioning process.

Device Wiring Schematics

Device Wiring Schematics



Number	Title	Description
E-182	Device Wiring Schematics	This sheet provides power distribution and manual (hand) selector switch wiring information. Refer to these sheets during the Commissioning process.

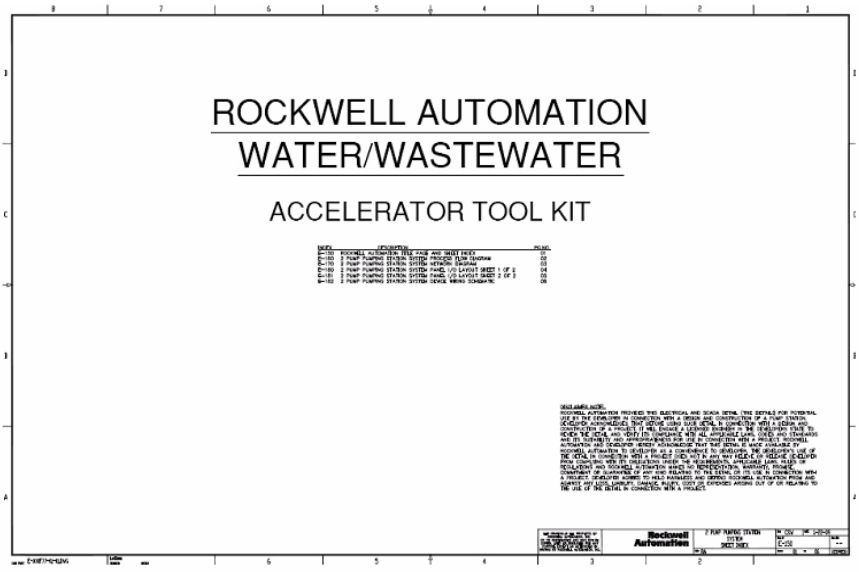
Dosing Pump Hardware Drawings

One of the System Architecture sub-folders on the WWWAT CD is the Dosing Pump folder and it contains the following drawings:

- Title Page and Sheet Index
- Process Flow Diagram
- Network Diagram
- Panel I/O Layout Sheets

Title Page and Sheet Index

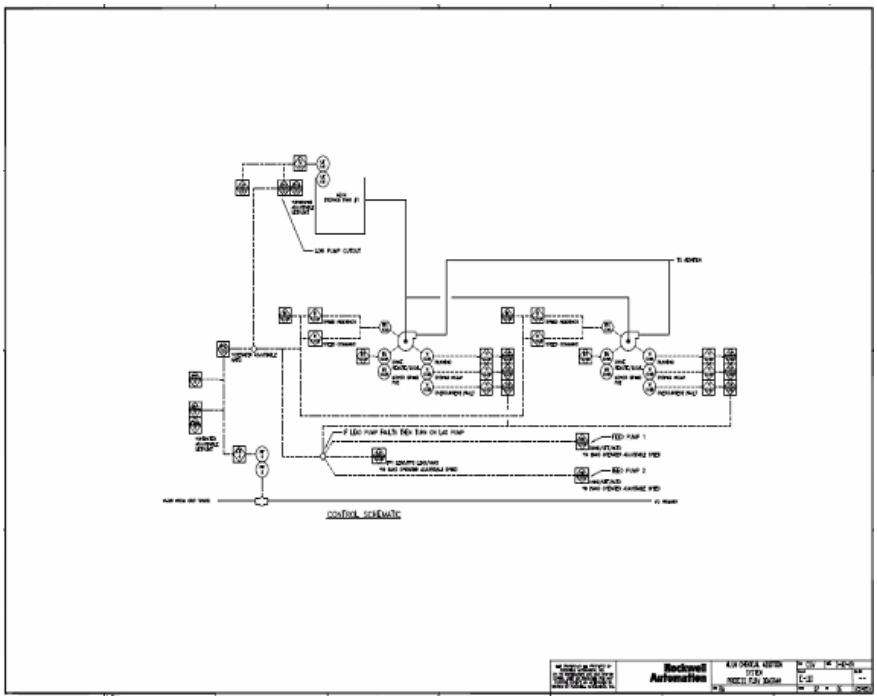
Dosing Pump Title Page and Sheet Index



Number	Title	Description
E-100	Title Page and Sheet Index	This is the Table of Contents/Cover Sheet for the drawing package. Modify this sheet as necessary to match the contents of your application's drawing package.

Process Flow Diagram

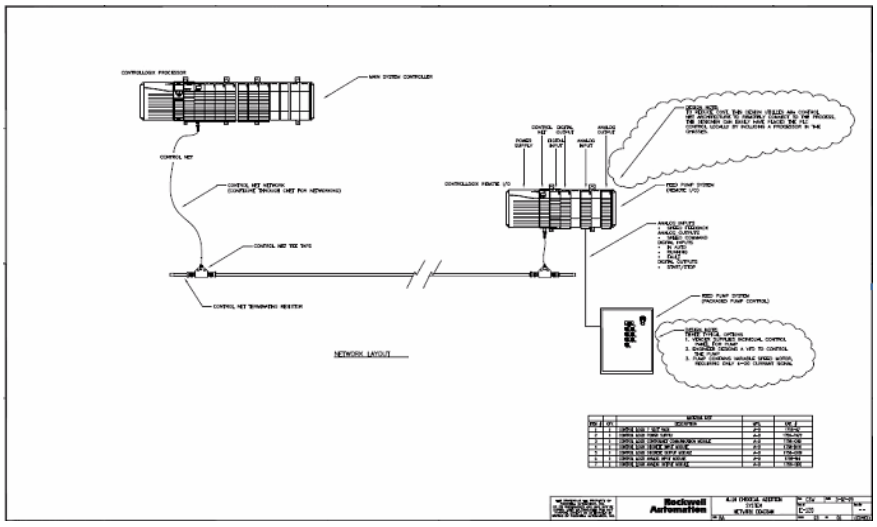
Dosing Pump System Process Flow Diagram



Number	Title	Description
E-110	System Process Flow Diagram	The Dosing Pump System Process Flow diagram depicts a two pump alum addition process. You make any changes to the number of pumps or I/O for this process on this drawing. For example, if you require additional pumps in an application, update this sheet with the appropriate pumps and their associated I/O information. The Dosing Pump System Process Flow diagram provides a general overview of the process controlled by the system, a quick summary of the controls involved, and the process that is being controlled.

Network Diagram

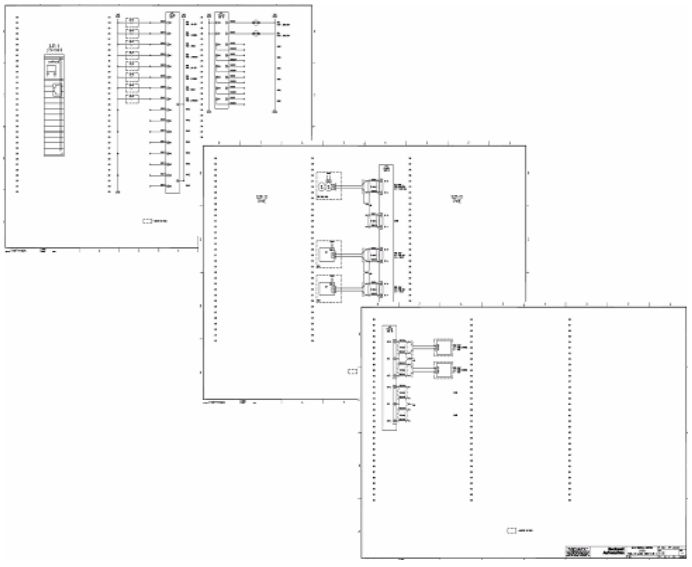
Dosing Pump Network Diagram



Number	Title	Description
E-170	Network Diagram	For details, see page 14.

Panel I/O Layout Sheets

Dosing Pump Panel I/O Layout Sheets



Number	Title	Description
E-130 E-131 E-132	Panel I/O Layout (Sheet 1 of 3) Panel I/O Layout (Sheet 2 of 3) Panel I/O Layout (Sheet 3 of 3)	The Dosing Pump System Panel I/O Layout Sheets show the I/O to the controller. The format uses three cards per sheet. This drawing depicts inputs to the card with the input device to the left of the input card. It also shows output devices to the right of the output card. You must add a new sheet for each additional input or output card. This drawing package was designed with space reserved for all the Controller Chassis card slots. In this example drawing package, slot 3 is empty. This empty slot is represented on sheet E-131 with an empty area on the sheet and the text "Spare." If you add a card to slot three, you should show it in this spare area. If an additional chassis is required, use this same format with space reserved in the drawings for any empty slots of the chassis. This provides a pre-determined location in the drawing package for all the I/O modules. Include I/O information specific to your application on this drawing. We expect you to modify these sheets to fit your application. You use these sheets as a template for use with many applications even though the specific I/O points vary. These sheets include digital input and output modules as well as analog input and output modules. The Dosing Pump Panel I/O Layout Sheet contains one example of each type of module that will typically be used in a lift station application. Note, that these modules are 1756 style I/O modules. Different I/O modules will require changes to these sheets.

Water Treatment Plant Hardware Drawings

The Water and Wastewater Treatment Plant (WTP) Hardware documentation package contains the following system-level drawing packages:

- Raw Water Intake Pump Station System
- Separation Station System
- High Service Pump Station System

The Raw Water Intake System Pump Station drawings are included in this section for reference. These are typical of the others- all can be found on the WWWAT CD (Publication IASIMP-SP012). You can also go to the Rockwell Automation Integrated Architecture Tools Website, http://www.ab.com/go/iatools and download the drawings.

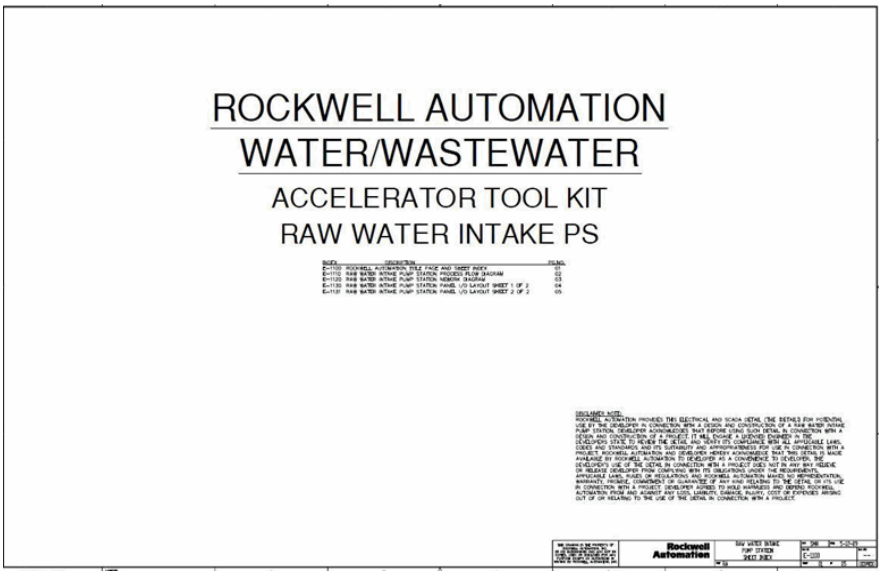
Raw Water Intake System Hardware Drawings

The System Architecture folder on the WWWAT CD contains the Raw Water Intake System sub-folder. Select this sub-folder to view the following Raw Water Intake System drawings:

- Title Page and Sheet Index
- Process Flow Diagram
- Network Diagram
- Panel I/O Layout Sheets

Title Page and Sheet Index

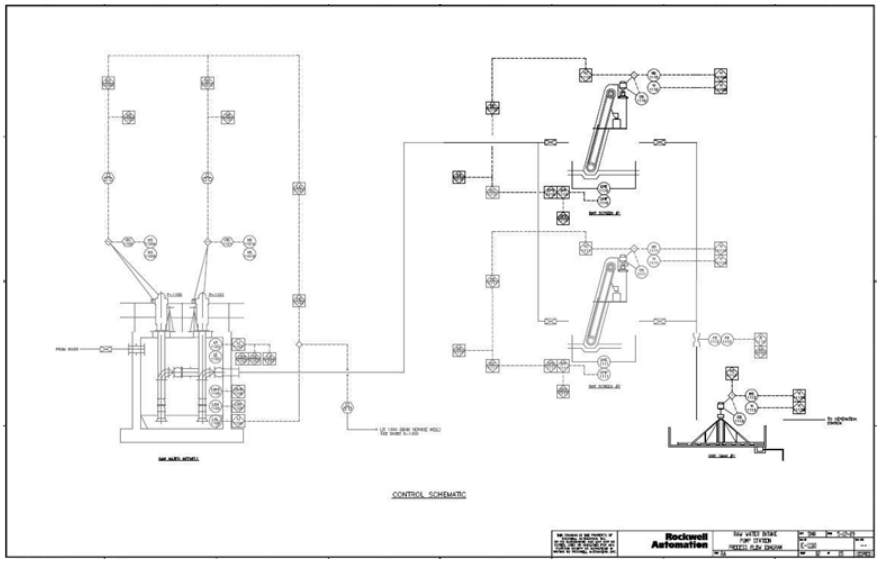
Raw Water Intake System Title Page and Sheet Index



Number	Title	Description
E-1100	Title Page and Sheet Index	This is the Table of Contents/Cover Sheet for the drawing package. Modify this sheet as necessary to match the contents of the drawing package for your application.

Process Flow Diagram

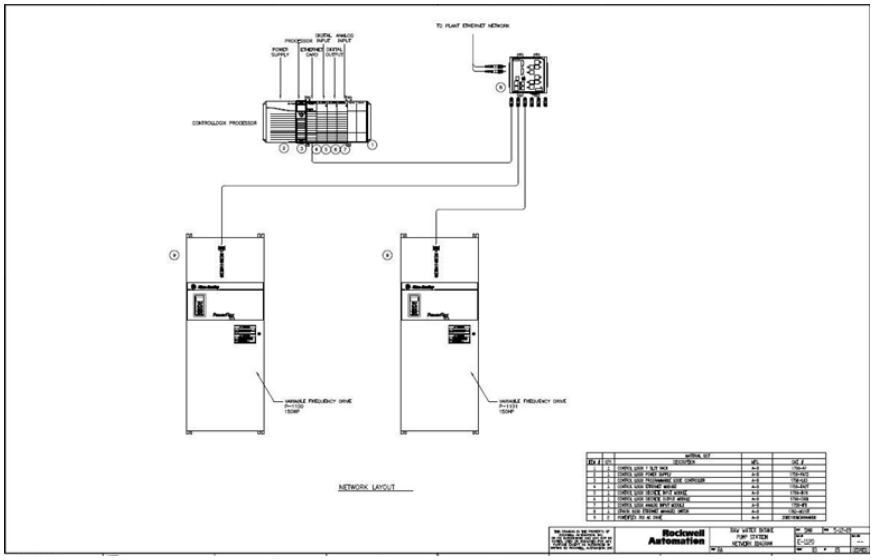
Raw Water Intake System Process Flow Diagram



Number	Title	Description
E-1110	System Process Flow Diagram	The Run Water Intake System Flow diagram depicts a Raw Water Intake System with particular I/O. Any changes to the I/O for the Raw Water Intake System should be reflected on this diagram. For example, if additional pumps are required in an application, you should update this sheet with those pumps and their associated I/O. A diagram like the one on this sheet shows a general overview of the process controlled by the system in this drawing set. It provides a quick summary of the controls involved and of the process that is being controlled.

Network Diagram

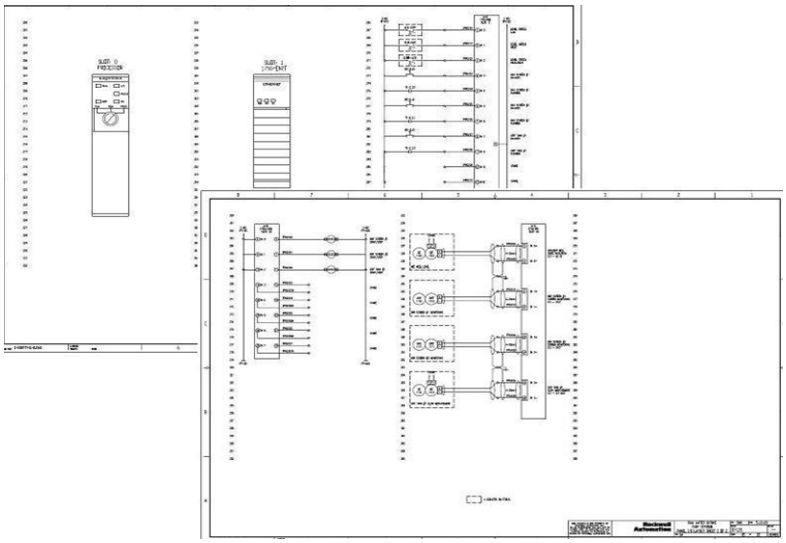
Raw Water Intake System Network Diagram



Number	Title	Description
E-1120	Network Diagram	For details, see page 23.

Panel I/O Layout Sheets

Raw Water Intake System Panel I/O Layout Sheets



Number	Title	Description
E-1130 E-1131	Panel I/O Layout (Sheet 1 of 2) Panel I/O Layout (Sheet 2 of 2)	The Run Water Intake System Panel I/O Layout Sheets depict inputs and outputs to the controller. This format uses three cards per sheet. Inputs to the card are shown with the input device to the left of the input card. Output devices are shown to the right of the output card. You must add a new drawing sheet for every additional input or output card. This drawing package reserves space for all the "slots" of a controller's chassis. If an additional chassis is required, use this same format with space reserved in the drawings for any empty slots of the chassis. This provides a pre-determined location in the drawing package for all the I/O modules. I/O specific to an application are shown here and it is expected that these sheets are heavily modified for each application. These sheets function as a template for many applications even if the specific I/O points vary. These sheets include digital input and output modules as well as analog input and output modules. This provides one example of each type of module that will typically be used in a Raw Water Intake System application. **Note:** This drawing depicts 1756 style I/O modules. If you use different I/O modules, you must also update these sheets. Refer to these sheets during the Commissioning process.

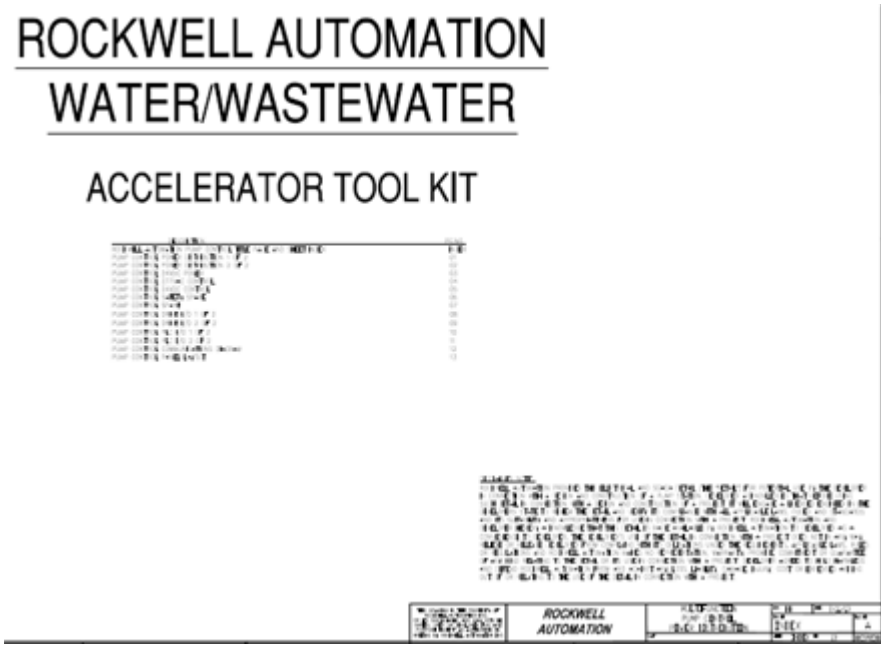
Pump Controller Station Hardware Drawings

One of the System Architecture sub-folders on the WWWAT CD is the Pump Controller Station folder and it contains the following drawings:

- Title Page and Sheet Index
- Communications Diagram
- Panel Layout Diagram
- Power Layout Sheets
- Panel I/O Layout Sheets

Title Page and Sheet Index

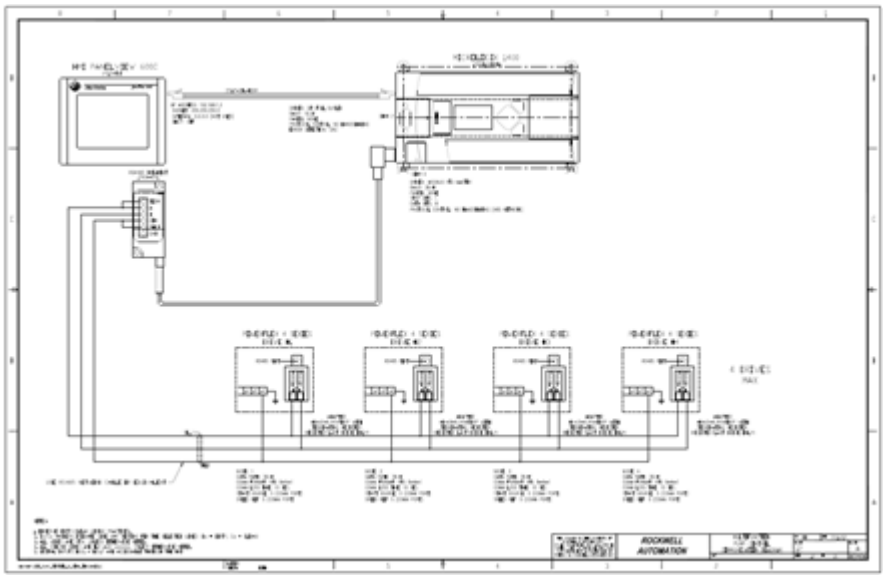
Pump Controller Station Title Page and Sheet Index



Number	Title	Description
Index	Title Page and Sheet Index	This is the Table of Contents/Cover Sheet for the drawing package. Modify this sheet as necessary to match the contents of the drawing package for your application.

Communications Diagram

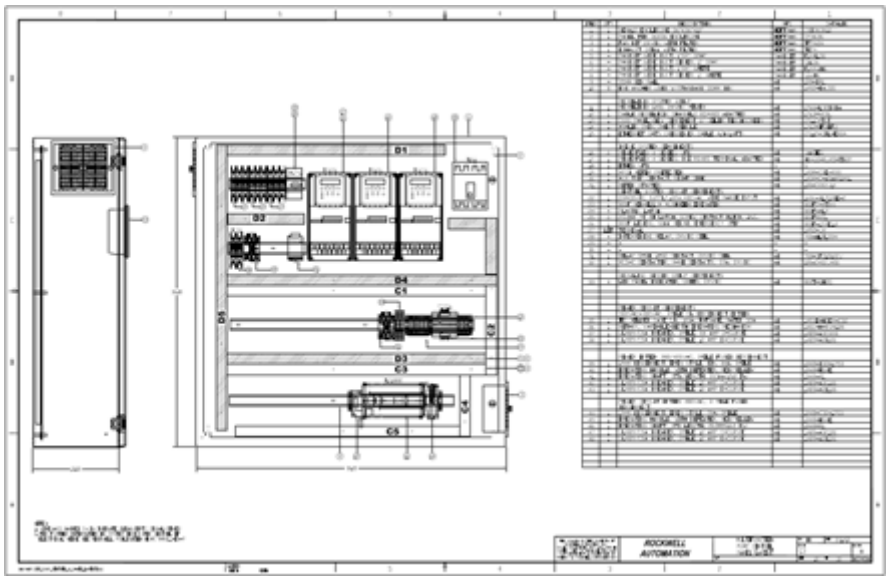
Pump Controller Station Communications Diagram



Number	Title	Description
E-12	Pump Control Communications Diagram	Refer to Pump Controller Station Architecture Drawing on page 28 for details.

Panel Layout Diagram

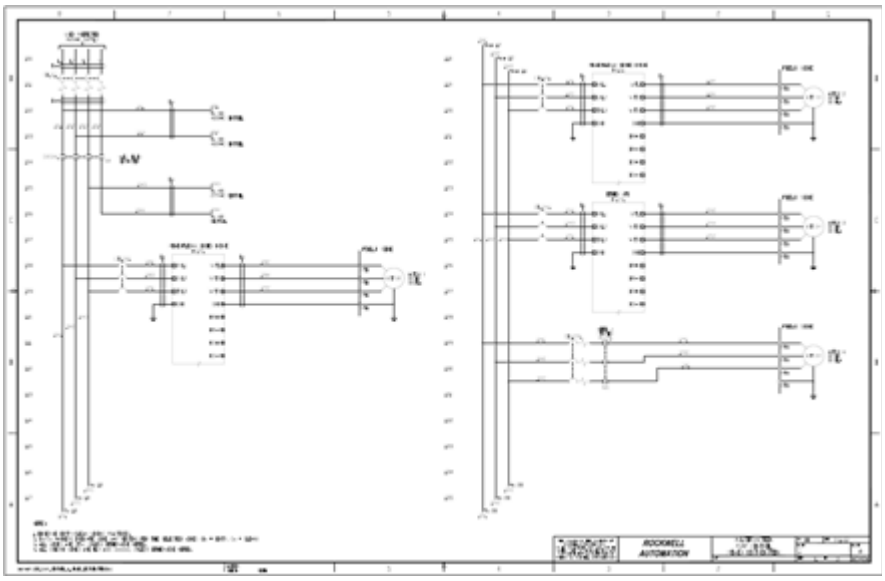
Pump Controller Station Panel Layout Diagram

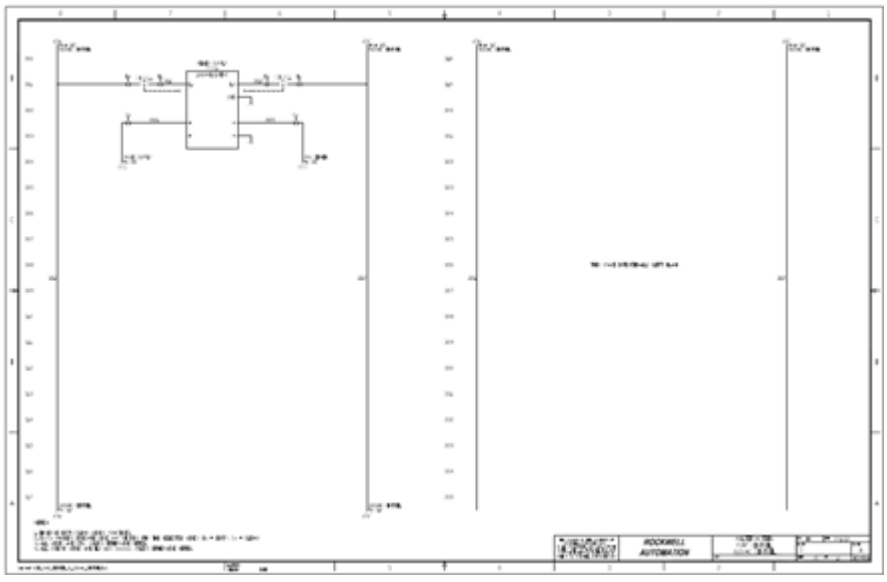


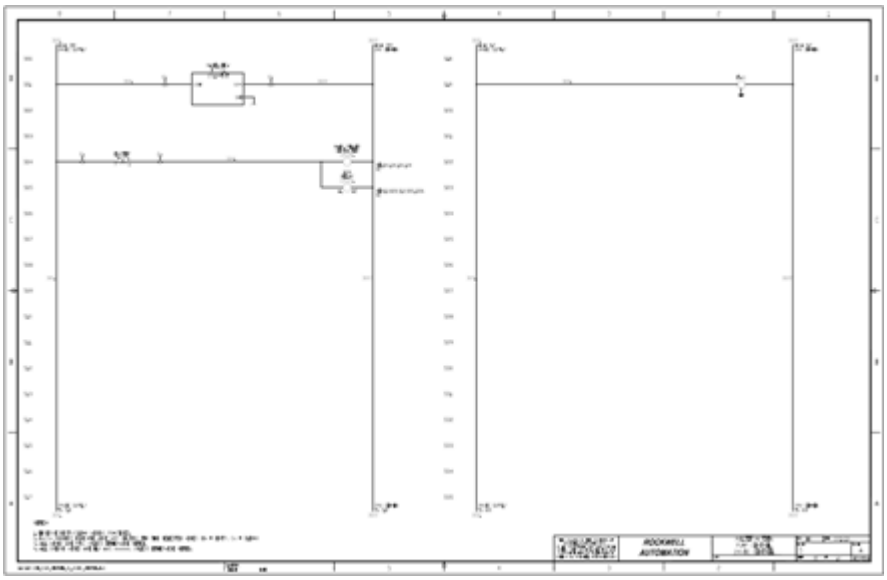
Number	Title	Description
13	Pump Controller Station Panel Layout Diagram	You can modify this as needed for your application requirements.

Power Layout Sheets

Pump Controller Station Power Layout Sheets



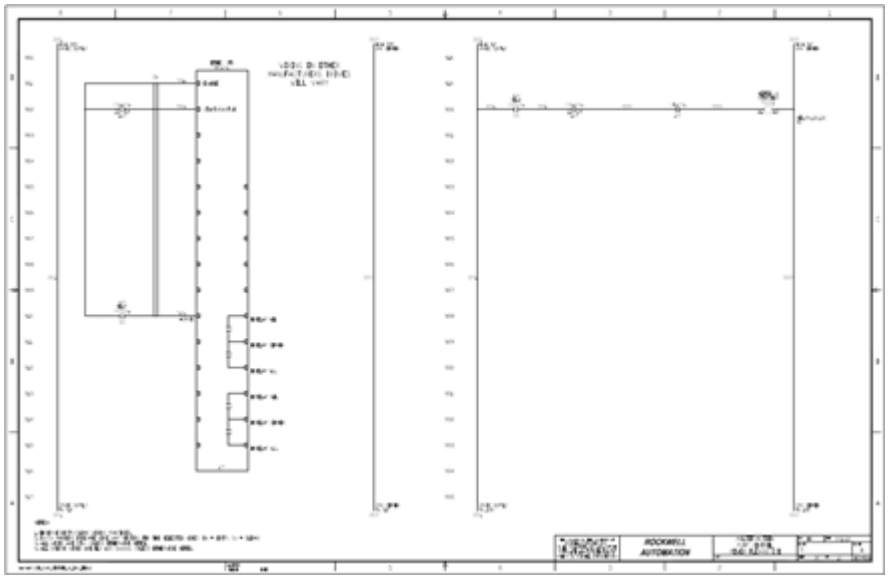


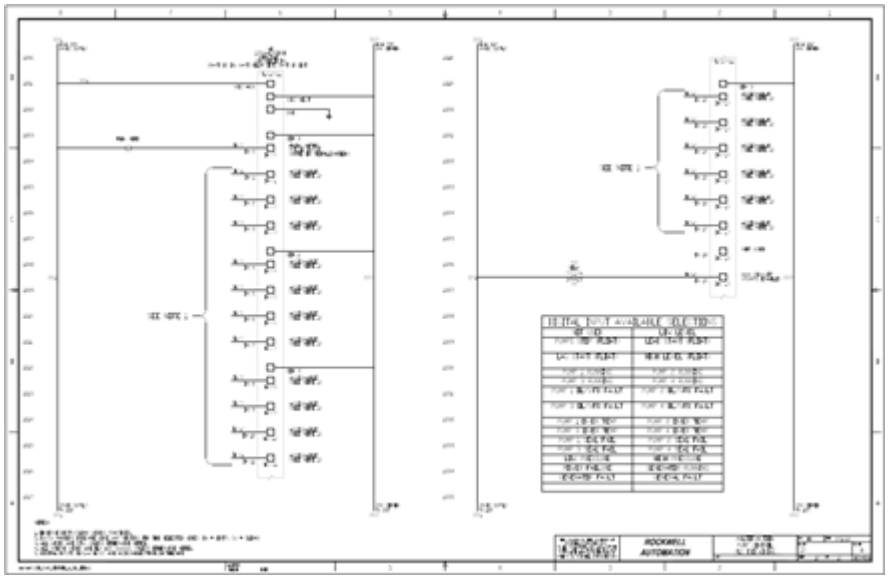


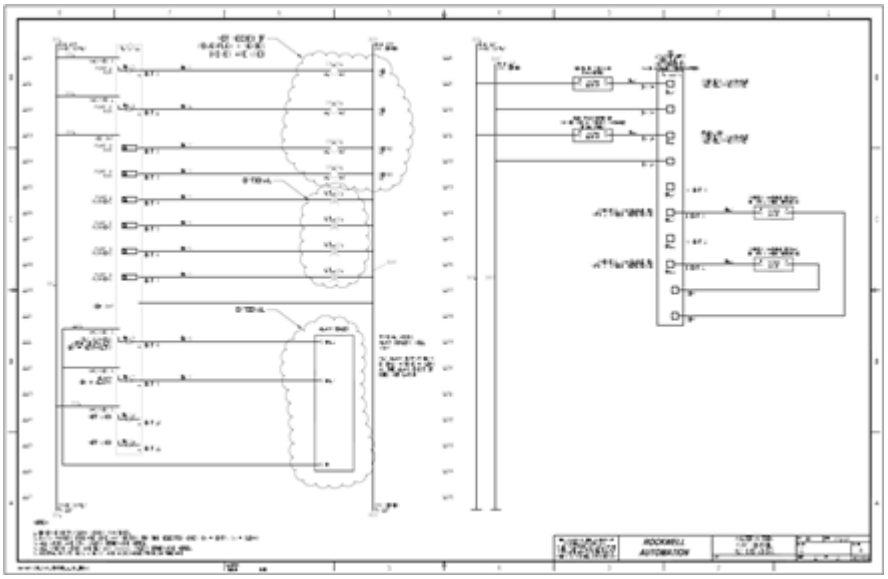
Number	Title	Description
1, 3 and 5	Power Layout Sheets	Pump Control Power Distribution, 480VAC Power, and 24VDC Power Drawings.

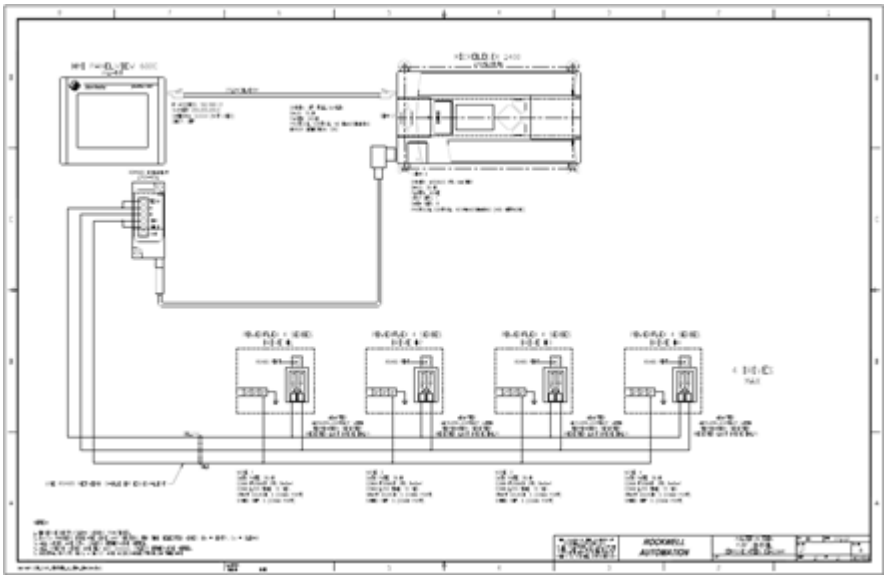
Panel I/O Layout Sheets

Pump Controller Station Panel I/O Layout Sheets









Number	Title	Description
8-11	I/O Layout Sheets	Pump Control Drive and PLC I/O Drawings.

Notes:

Maintenance and Repair

Introduction

This chapter contains valuable resources to help you install and begin to use the Water and Wastewater system. Use the following table to locate these resources.

To Access	See
Website resources for additional information, including: • Rockwell Automation product and knowledge base websites • Water and Wastewater industry websites	Website Resources on page 319
Related documentation to help you install/commission the Water and Wastewater system. This chapter lists the necessary user and quick start guides required to install/bring your system online.	Documentation Resources on page 320

Important Maintenance and Repair Drawings

Once your Water and Wastewater system is installed, it requires periodic planned maintenance and/or repair to keep it working properly. Refer to these drawings for specific technical/electrical system information when your system requires service.

Water and Wastewater Treatment Plant Hardware Drawings

The Water and Wastewater Treatment Plant Hardware documentation package contains the following system-level packages:

- Lift Station Hardware Drawings
- Dosing Pump Hardware Drawings
- Primary Treatment System Hardware Drawings
- Headworks Pump Hardware Drawings
- Secondary Treatment System Hardware Drawings
- Solids Handling System Hardware Drawings
- Chemical Feed System Hardware Drawings
- Flushing System Hardware Drawings

The Lift Station and Dosing Pump Station drawings are included in this section for reference. These are typical of the others- all can be found on the WWWAT CD (Publication IASIMP-SP012). You can also go to the Rockwell Automation Integrated Architecture Tools Website, http://www.ab.com/go/iatools and download the drawings.

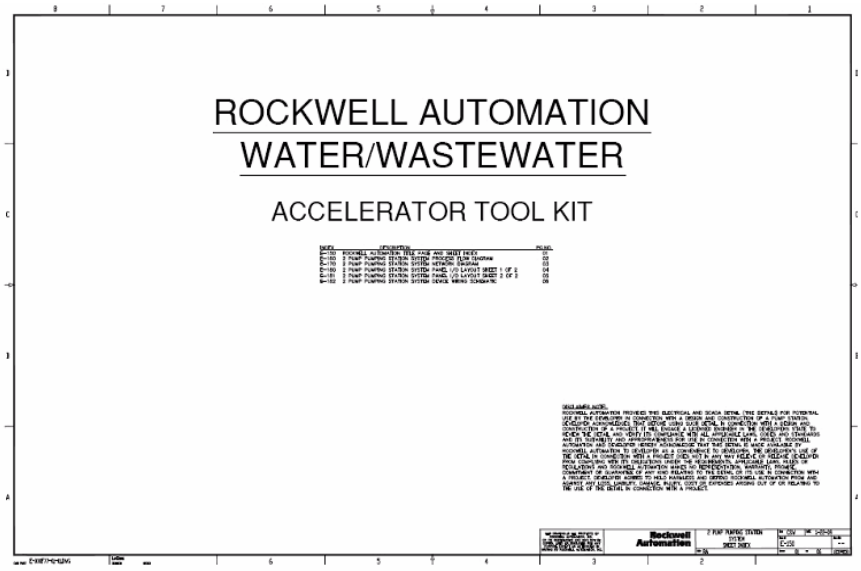
Lift Station Hardware Drawings

One of the System Architecture sub-folders on the WWWAT CD is the Lift Station folder and it contains the following drawings:

- Title Page and Sheet Index
- Process Flow Diagram
- Network Diagram
- Panel I/O Layout Sheets
- Device Wiring Schematics

Title Page and Sheet Index

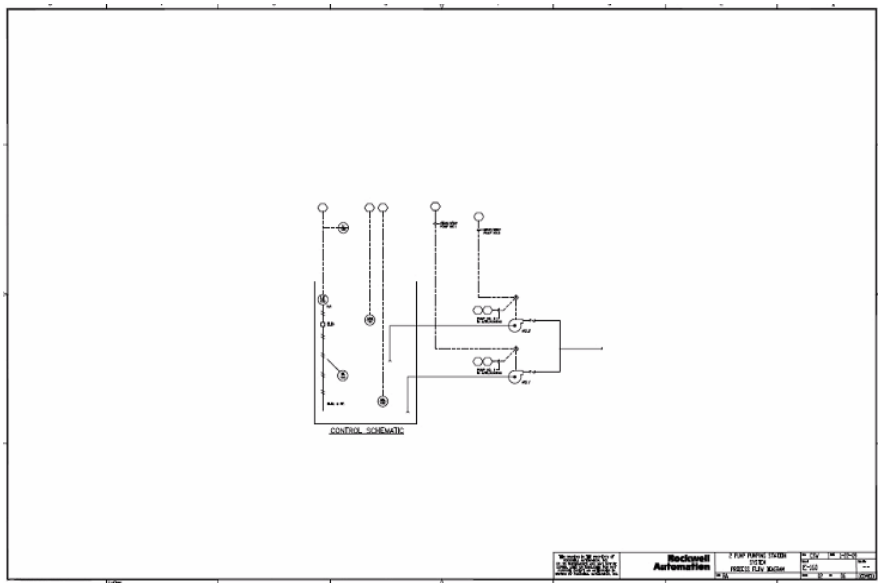
Lift Station Title Page and Sheet Index



Number	Title	Description
E-150	Title Page and Sheet Index	This is the Table of Contents/Cover Sheet for the drawing package. Modify this sheet as necessary to match the contents of the drawing package for your application.

Process Flow Diagram

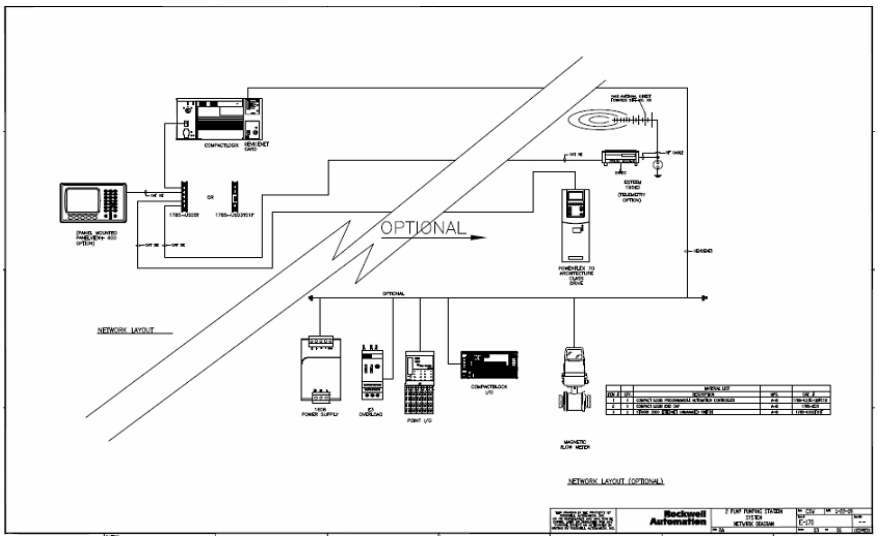
Lift Station System Process Flow Diagram



Number	Title	Description
E-160	System Process Flow Diagram	This diagram depicts a Lift Station consisting of two pumps with particular I/O. It provides a general overview of the process controlled by the system, a quick summary of the controls involved, and the process that is being controlled.

Network Diagram

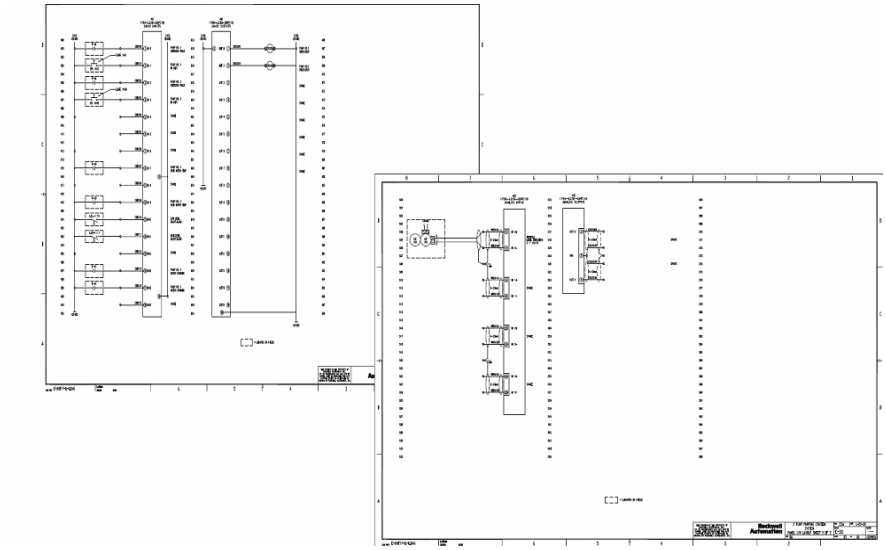
Network Diagram



Number	Title	Description
E-170	Network Diagram	For details, see page 12.

Panel I/O Layout Sheets

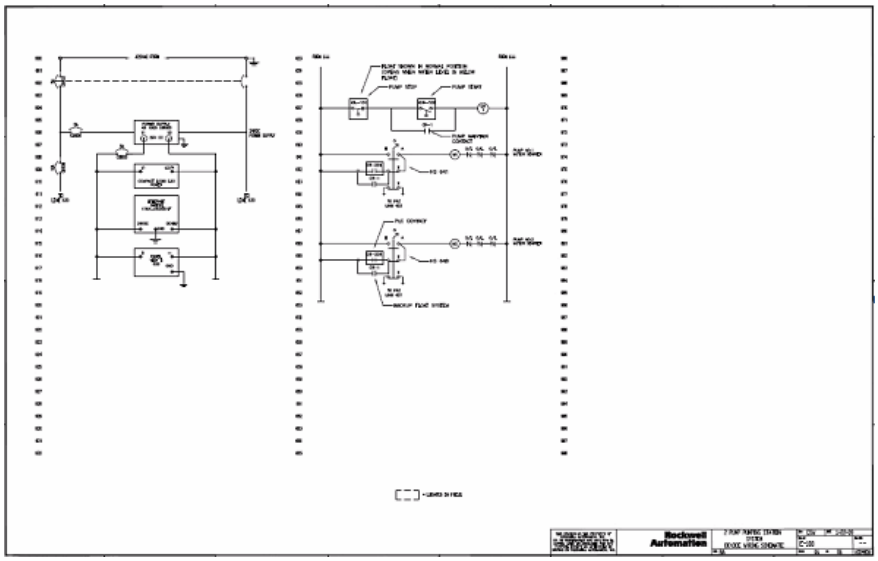
Lift Station Panel I/O Layout Sheets



Number	Title	Description
E-180	Panel I/O Layout (Sheet 1 of 2)	Inputs and outputs to the controller are shown on these diagrams. The format uses three cards per sheet. Inputs to the card are shown with the input device to the left of the input card. Output devices are shown to the right of the output card. For every additional input or output card, new sheets must be added.
E-181	Panel I/O Layout (Sheet 2 of 2)	

Device Wiring Schematics

Device Wiring Schematics



Number	Title	Description
E-182	Device Wiring Schematics	This sheet provides power distribution and manual (hand) selector switch wiring information. Refer to these sheets during the Commissioning process.

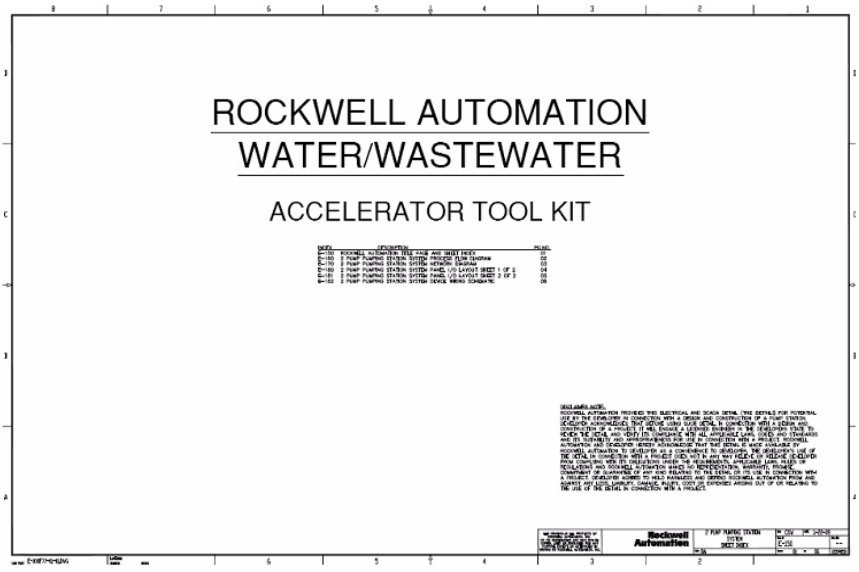
Dosing Pump Hardware Drawings

One of the System Architecture sub-folders on the WWWAT CD is the Dosing Pump folder and it contains the following drawings:

- Title Page and Sheet Index
- Process Flow Diagram
- Network Diagram
- Panel I/O Layout Sheets

Title Page and Sheet Index

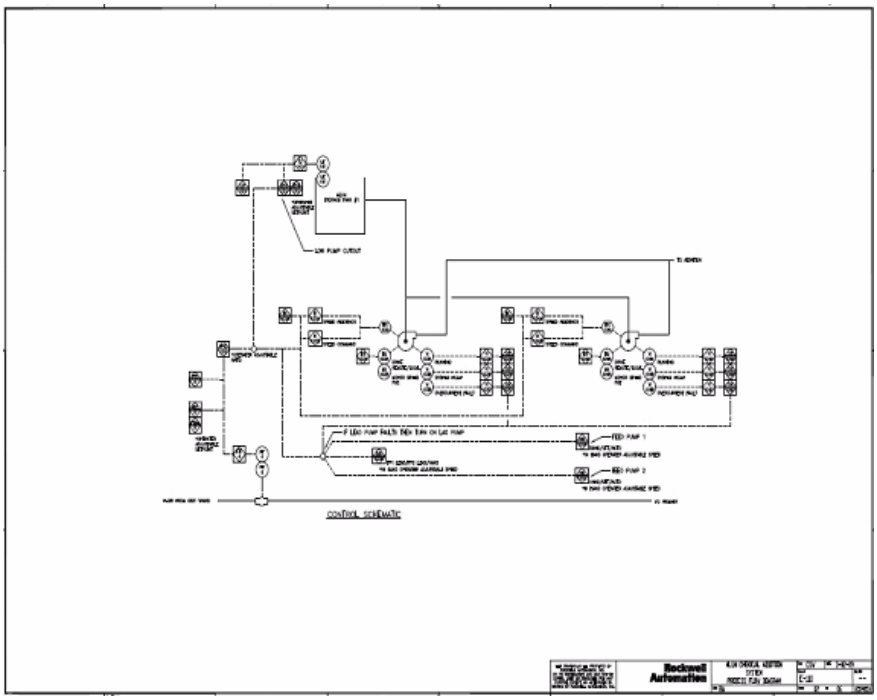
Dosing Pump Title Page and Sheet Index



Number	Title	Description
E-100	Title Page and Sheet Index	This is the Table of Contents/Cover Sheet for the drawing package. Modify this sheet as necessary to match the contents of your application's drawing package.

Process Flow Diagram

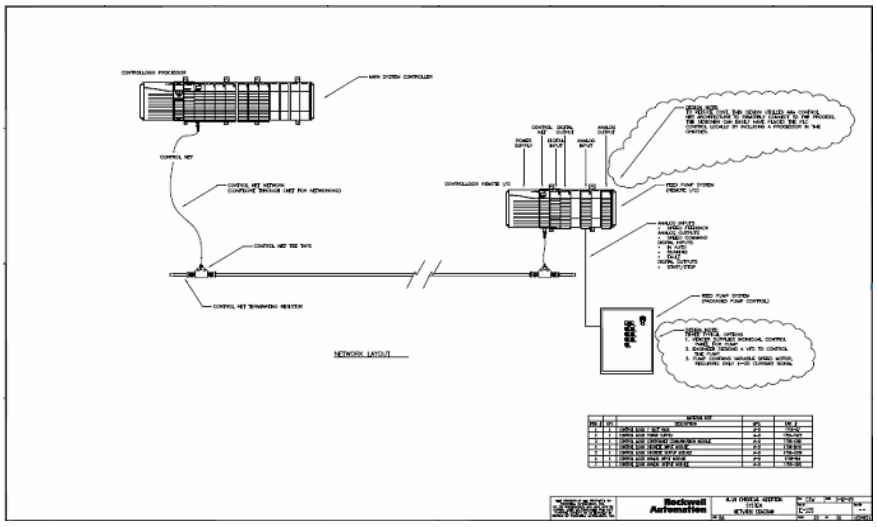
Dosing Pump System Process Flow Diagram



Number	Title	Description
E-110	System Process Flow Diagram	The Dosing Pump System Process Flow diagram depicts a two pump alum addition process. Make any changes to the number of pumps or I/O for this process on this drawing. For example, if you require additional pumps in an application, update this sheet with the appropriate pumps and their associated I/O information. The Dosing Pump System Process Flow diagram provides a general overview of the process controlled by the system, a quick summary of the controls involved, and the process that is being controlled.

Network Diagram

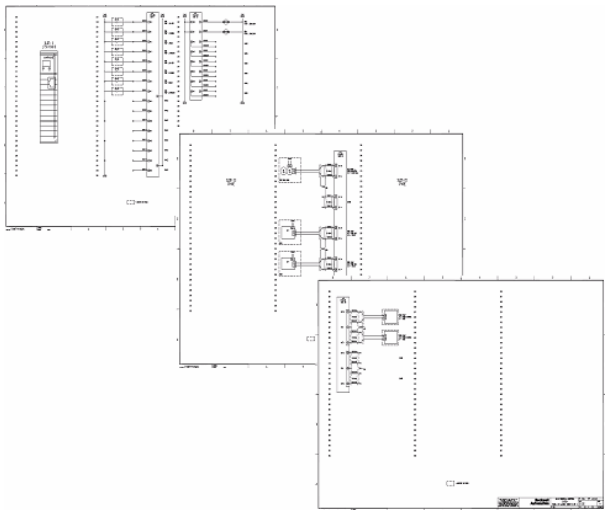
Dosing Pump Network Diagram



Number	Title	Description
E-120	Network Diagram	For details, see page page 14.

Panel I/O Layout Sheets

Dosing Pump Panel I/O Layout Sheets



Number	Title	Description
E-130	Panel I/O Layout (Sheet 1 of 3)	These diagrams show the I/O to the controller. The format uses three cards per sheet. This drawing depicts inputs to the card with the input device to the left of the input card. It also shows output devices to the right of the output card. You must add a new sheet for each additional input or output card. This drawing package was designed with space reserved for all controller chassis card slots. In this example drawing package, slot 3 is empty. This empty slot is represented on sheet E-131 with an empty area on the sheet and the text "Spare." If you add a card to slot 3, show it in this spare area. If an additional chassis is required, use this same format with space reserved in the drawings for any empty slots of the chassis. This provides a pre-determined location in the drawing package for all the I/O modules. Include I/O information specific to your application on this drawing. We expect you to modify these sheets to fit your application. Use these sheets as a template for use with many applications even though the specific I/O points vary. These sheets include digital input and output modules as well as analog input and output modules. The Dosing Pump Panel I/O Layout Sheet contains one example of each type of module that will typically be used in a lift station application. Note, that these modules are 1756 style I/O modules. Different I/O modules will require changes to these sheets.
E-131	Panel I/O Layout (Sheet 2 of 3)	
E-132	Panel I/O Layout (Sheet 3 of 3)	

Water Treatment Plant Hardware Drawings

The Water Treatment Plant Hardware documentation package contains the following system-level packages:

- Raw Water Intake System Hardware Drawings
- Separation Station System Hardware Drawings
- High Service Pump Station System Hardware Drawings

The Raw Water Intake System Pump Station drawings are included in this section for reference. These are typical of the others- all can be found on the WWWAT CD (Publication IASIMP-SP012). You can also go to the Rockwell Automation Integrated Architecture Tools Website, http://www.ab.com/go/iatools and download the drawings.

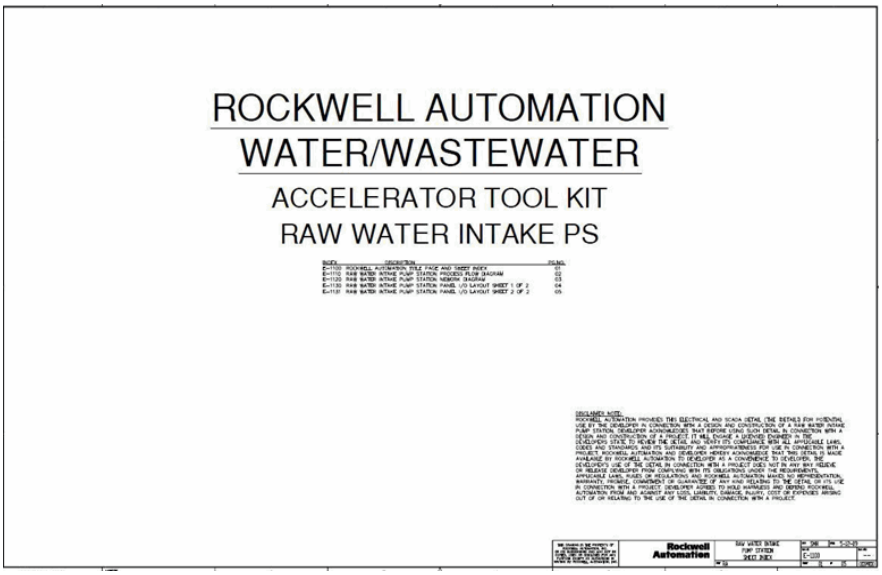
Raw Water Intake System Hardware Drawings

The System Architecture folder on the WWWAT CD contains the Raw Water Intake System sub-folder. Select this sub-folder to view the following Raw Water Intake System drawings:

- Title Page and Sheet Index
- Process Flow Diagram
- Network Diagram
- Panel I/O Layout Sheets

Title Page and Sheet Index

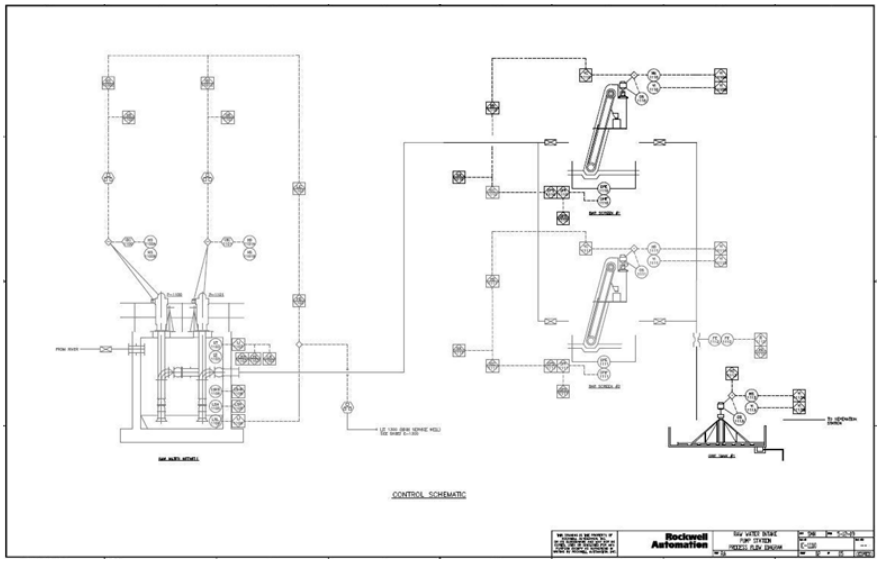
Raw Water Intake System Title Page and Sheet Index



Number	Title	Description
E-1100	Title Page and Sheet Index	This is the Table of Contents/Cover Sheet for the drawing package. Modify this sheet as necessary to match the contents of the drawing package for your application.

Process Flow Diagram

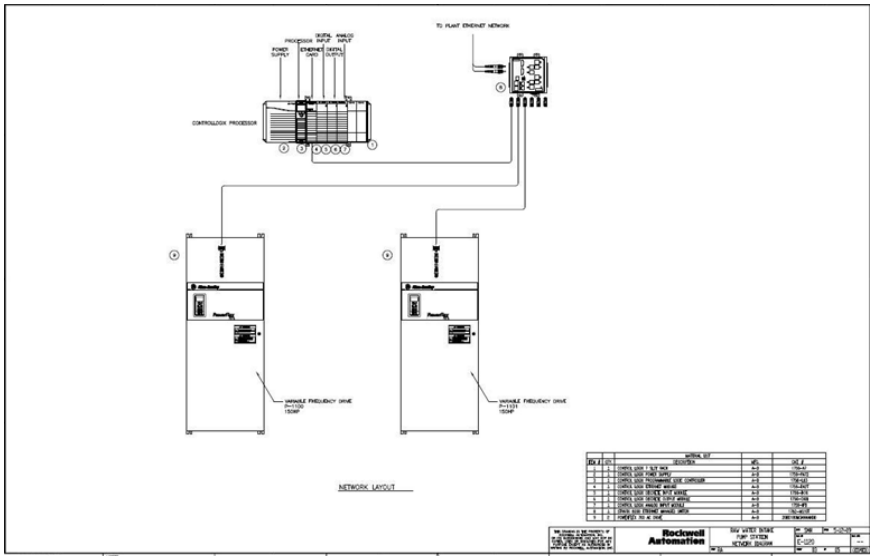
Raw Water Intake System Process Flow Diagram



Number	Title	Description
E-1110	System Process Flow Diagram	The flow diagram depicts a Raw Water Intake System with particular I/O. Any changes to the I/O for the Raw Water Intake System should be reflected on this diagram. For example, if additional pumps are required in an application, you should update this sheet with those pumps and their associated I/O. The Raw Water Intake System Process Flow diagram shows a general overview of the Raw Water Intake process controlled by the system in this drawing set. It provides a quick summary of the controls involved and of the process that is being controlled.

Network Diagram

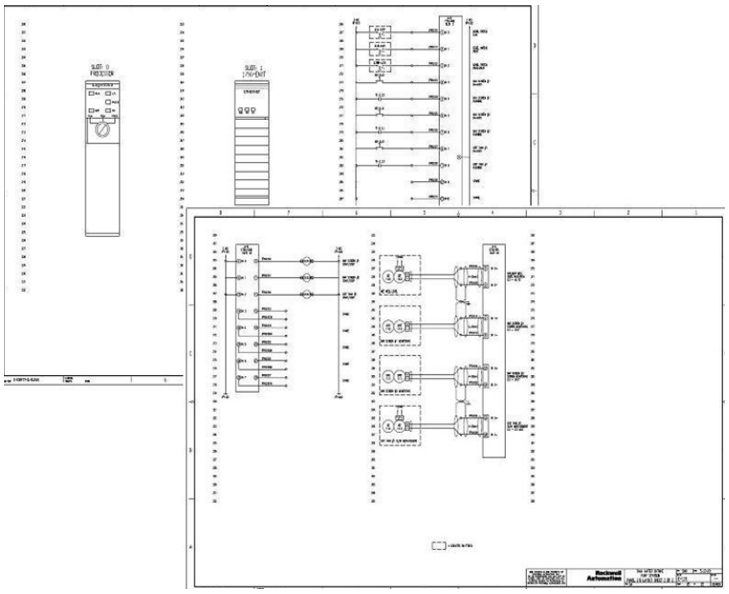
Raw Water Intake System Network Diagram



Number	Title	Description
E-1120	Network Diagram	For details, see page 23.

Panel I/O Layout Sheets

Raw Water Intake Panel I/O Layout Sheets



Number	Title	Description
E-1130 E-1131	Panel I/O Layout (Sheet 1 of 2) Panel I/O Layout (Sheet 2 of 2)	The Raw Water Intake Panel I/O Layout Sheets depict inputs and outputs to the controller. This format uses three cards per sheet. Inputs to the card are shown with the input device to the left of the input card. Output devices are shown to the right of the output card. You must add a new drawing sheet for every additional input or output card. This drawing package reserves space for all the "slots" of a controller's chassis. If an additional chassis is required, use this same format with space reserved in the drawings for any empty slots of the chassis. This provides a pre-determined location in the drawing package for all the I/O modules. I/O specific to an application are shown here and it is expected that these sheets are heavily modified for each application. These sheets provide a template for use for many applications even if the specific I/O points vary. These sheets include digital input and output modules as well as analog input and output modules. This provides one example of each type of module that will typically be used in a Raw Water Intake System application. **Note:** This drawing depicts 1756 style I/O modules. If you use different I/O modules, you must also update these sheets.

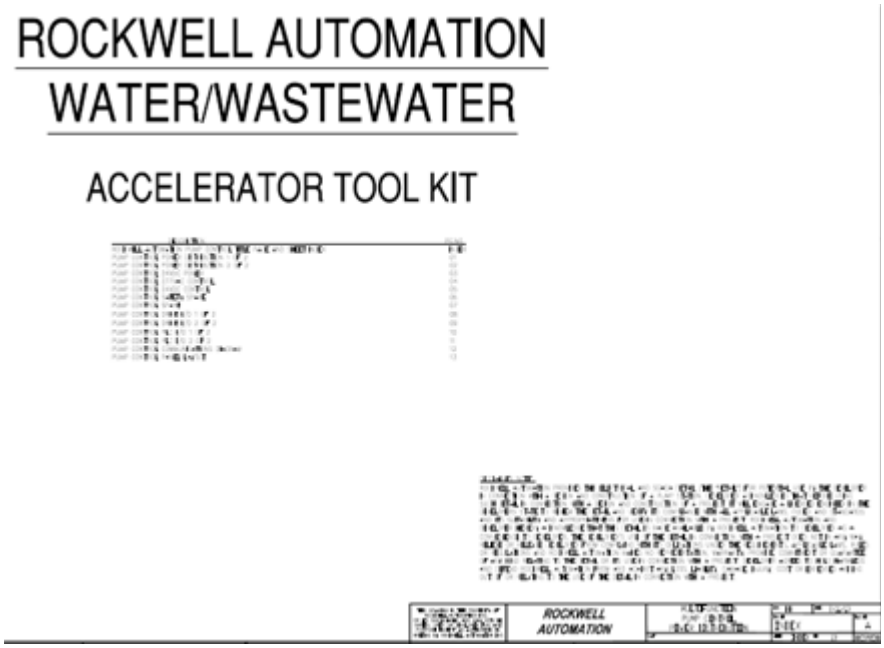
Pump Controller Station Hardware Drawings

One of the System Architecture sub-folders on the WWWAT CD is the Pump Controller Station folder and it contains the following drawings:

- Title Page and Sheet Index
- Communications Diagram
- Panel Layout Diagram
- Power Layout Sheets
- Panel I/O Layout Sheets

Title Page and Sheet Index

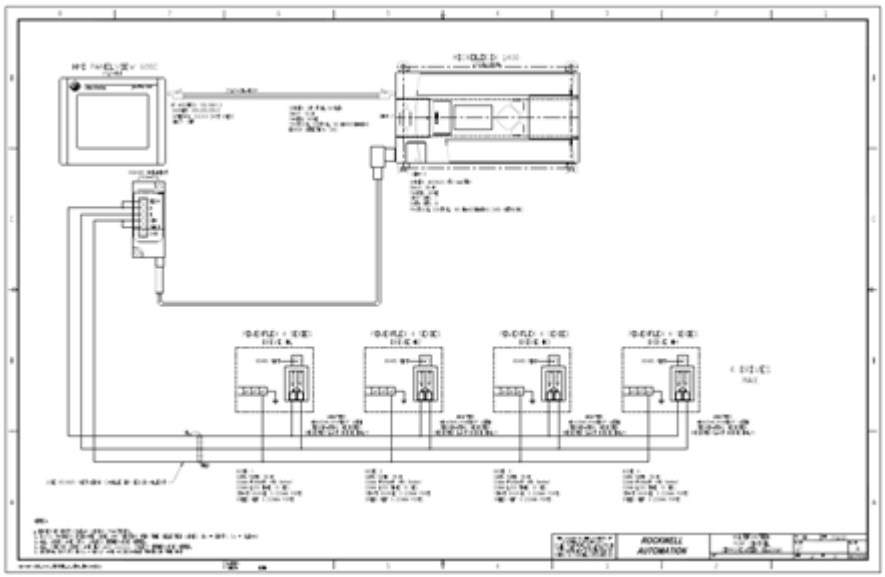
Pump Controller Station Title Page and Sheet Index



Number	Title	Description
Index	Title Page and Sheet Index	This is the Table of Contents/Cover Sheet for the drawing package. Modify this sheet as necessary to match the contents of the drawing package for your application.

Communications Diagram

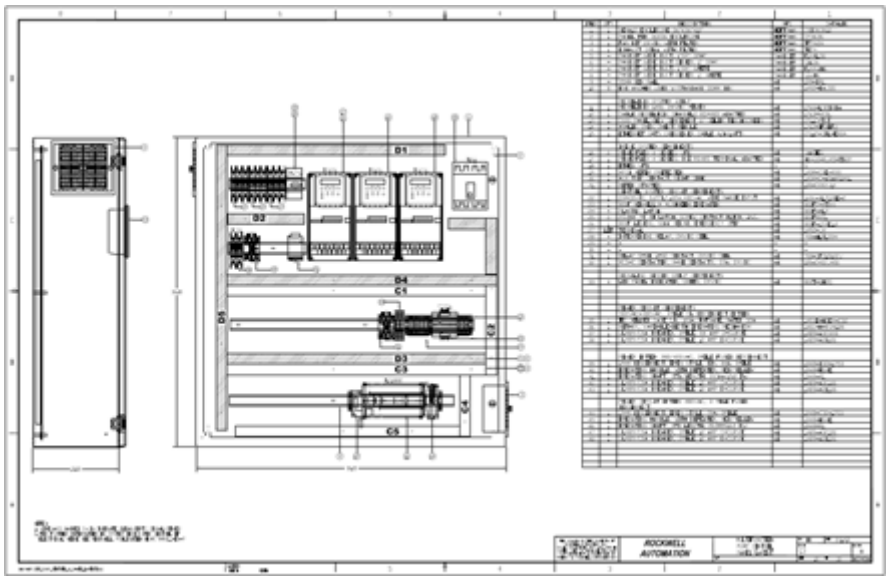
Pump Controller Station Communications Diagram



Number	Title	Description
E-12	Pump Control Communications Diagram	Refer to Pump Controller Station Architecture Drawing on page 28 for details.

Panel Layout Diagram

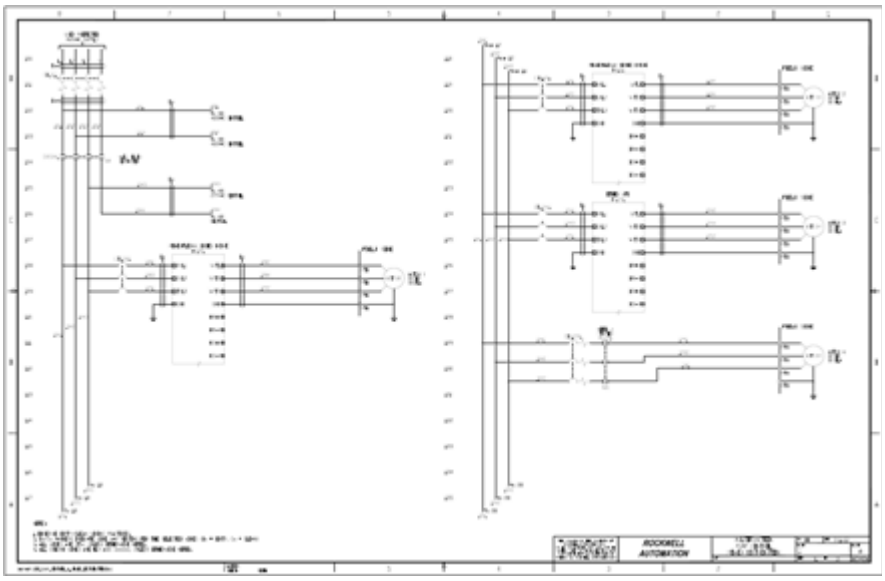
Pump Controller Station Panel Layout Diagram

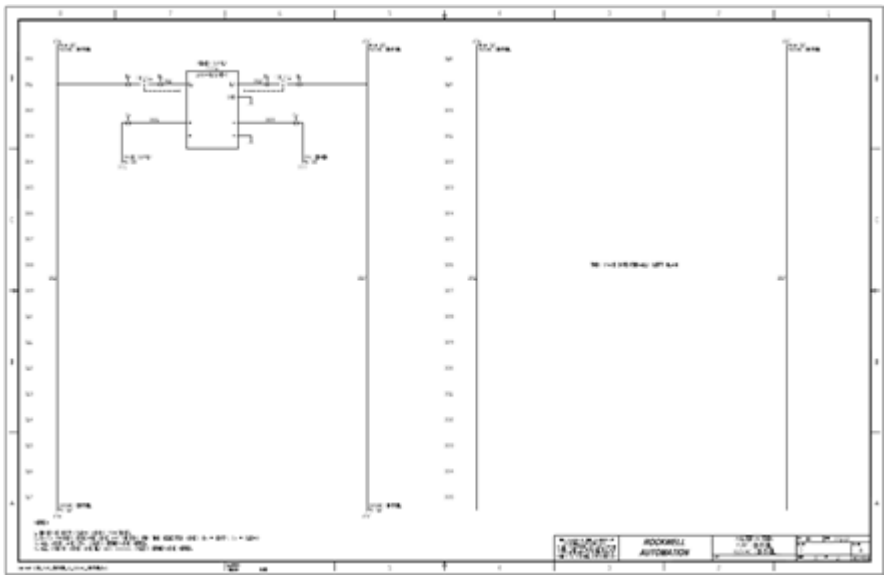


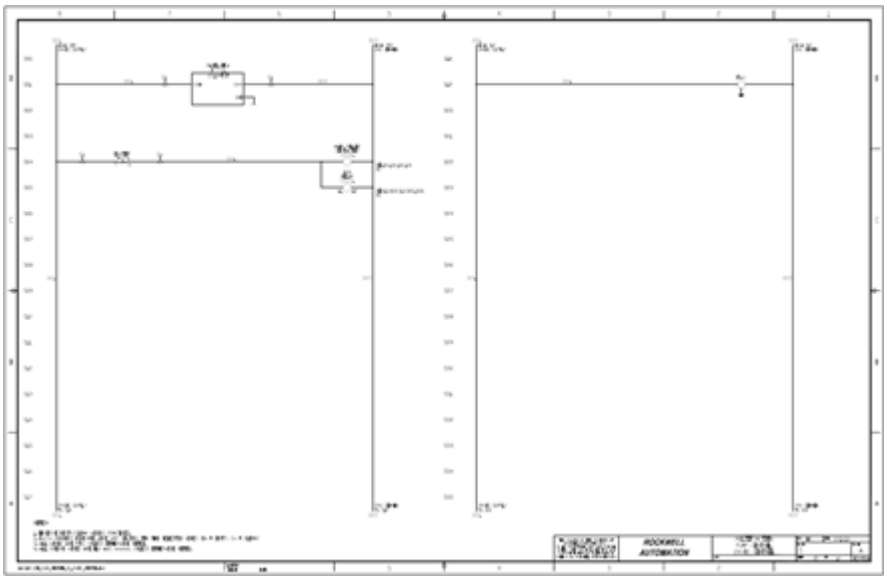
Number	Title	Description
13	Pump Controller Station Panel Layout Diagram	You can modify this as needed for your application requirements.

Power Layout Sheets

Pump Controller Station Power Layout Sheets



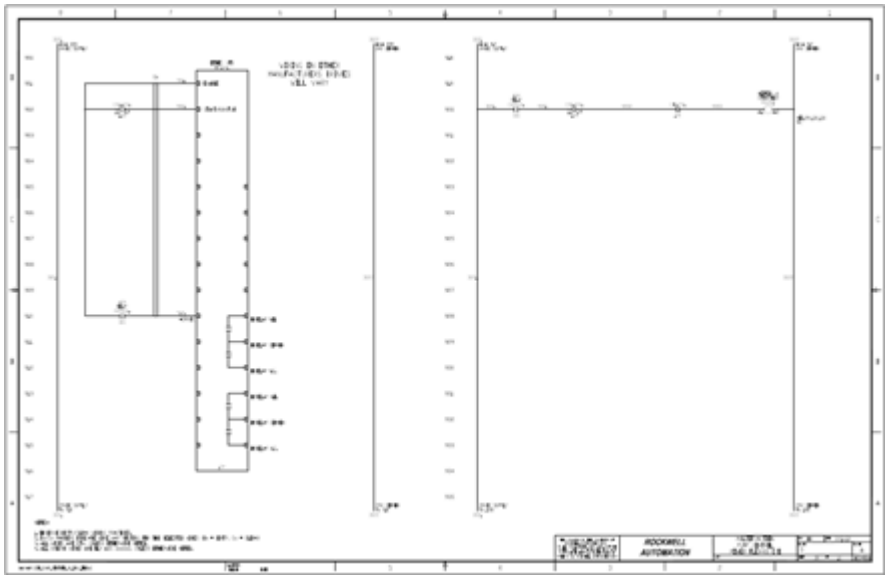


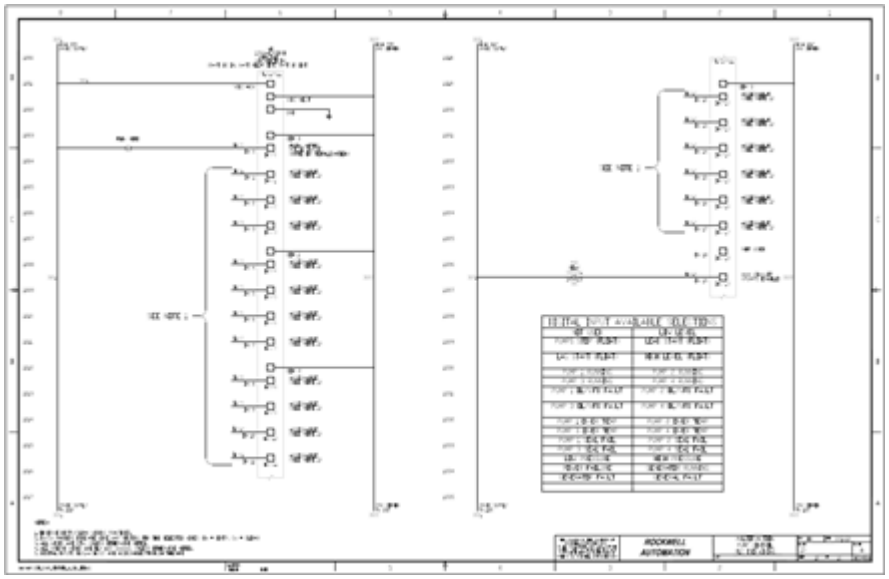


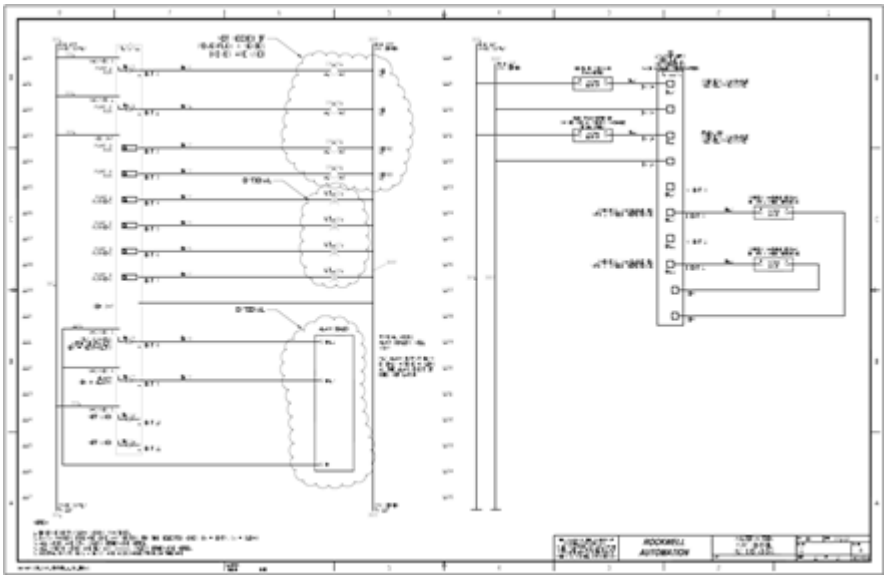
Number	Title	Description
1, 3 and 5	Power Layout Sheets	Pump Control Power Distribution, 480VAC Power, and 24VDC Power Drawings.

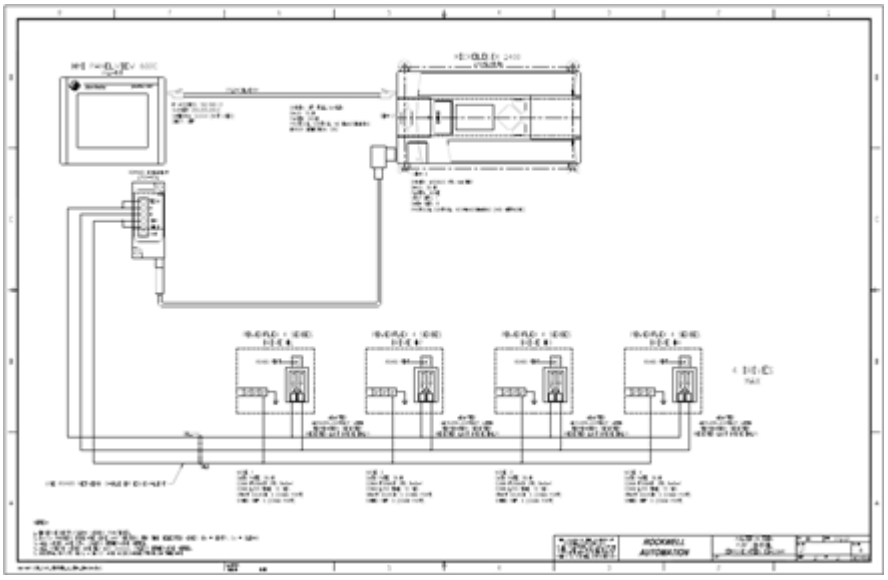
Panel I/O Layout Sheets

Pump Controller Station Panel I/O Layout Sheets









Number	Title	Description
8-11	I/O Layout Sheets	Pump Control Drive and PLC I/O Drawings.

Notes:

Additional Resources

Website Resources

This table describes the numerous websites where you can go to find useful and up-to-date information for all phases of a Water and Wastewater project. Each website is categorized on the WWWAT CD and contains a link to that specific website.

For	See
Integrated Architecture	
Productivity tools to help you save time in the development of your water or wastewater system.	http://rockwellautomation.com/solutions/integratedarchitecture/resources.html
General information about Rockwell Automation offerings in the water and wastewater industries.	http://www.rockwellautomation.com/industries/water/
Components	
Time-saving accelerators centered around Rockwell Automation components.	http://rockwellautomation.com/components/connected
Technical information about component-level products from Rockwell Automation.	http://rockwellautomation.com/components/connected
Literature	
Rockwell Automation manuals and publications.	http://www.rockwellautomation.com/literature
Selection, Configuration, and Support Information	
An interactive product selection tool that assists you in catalog generation.	http://www.ab.com/e-tools/
An interactive product selection tool that assists you in choosing the correct Rockwell Automation product for your application.	http://www.rockwellautomation.com/en/e-tools/configuration.html
CAD drawings of Rockwell Automation products.	http://www.rockwellautomation.com/en/e-tools/drawings.html
Answers to technical questions and solutions to problems.	http://support.rockwellautomation.com/
General technical support.	http://support.rockwellautomation.com/
Product Information	
Allen-Bradley product information.	http://www.ab.com
CompactLogix product information.	http://www.ab.com/programmablecontrol/pac/compactlogix/index.html
PanelView product information.	http://www.ab.com/eoi/graphicterminals
PowerFlex drives product information.	http://www.ab.com/drives
Power supply information.	http://www.ab.com/industrialcontrols/products/power_supplies

Documentation Resources

The WWWAT CD contains Rockwell Automation user manuals and installation instructions that you can refer to while designing your application. This table lists each document's publication number, folder location, and describes its content, so you can quickly locate the required information. The publications can be found on the CD in the folder WWWAT Common Tools>Product Information.

Documentation Stored On the WWWAT CD

Document Name	Publication Number	WWWAT CD Folder	Document Contents	Reference For
CompactLogix Packaged Controller Installation Instructions	1769-IN082	L2X Controller Information	• Installation Checklist • Controller Dimensions • How to Install the Battery • How to Connect Expansion Modules • Minimum Spacing Requirements • How to Panel Mount • How to DIN Rail Mount • Grounding Considerations • Wiring Power to the System • Wire the I/O Removable Terminal Blocks • Expansion Module Wiring • Selecting Operating Mode • Status Indicators	Hardware Selection Installation and Start-up
PanelView Plus Installation Manual	2711P-IN002	PanelView Plus Information	• Environmental Information • Mounting Clearances • Cutout Dimensions • Panel Mounting Instructions • Product Dimensions • Removing and Installing the Power Terminal Block • DC Power Connections • AC Power Connections • Troubleshooting • Battery Removal • System Specifications • Certifications	Hardware Selection
PowerFlex 70 User Manual	20A-UM001	PowerFlex 70 Information	• Installation / Wiring • Mounting • AC Supply • Grounding • Fusing • Power Wiring • IP66 (Nema 4X/12) Installations • Input/Output Contactors • MOVs and CM Capacitors • I/O Wiring • Speed Reference Control • Auto / Manual Examples • EMC Instructions • Appendix A - Supplemental Drive Information • Appendix B - HMI Overview • Appendix C - Application Notes	Hardware Selection Installation and Start-up Maintenance

Documentation Stored On the WWWAT CD

Document Name	Publication Number	WWWAT CD Folder	Document Contents	Reference For
E3 and E3 Plus Overload Relays User Manual	193-UM002	E3 Overload Information	• Product Overview • Installation and Wiring • Protective Trip and Warning Functions • DeviceNet Node Commissioning • Programmable Parameters • Current Monitoring Parameters • Diagnostic Parameters • Logic Controller Application Example with Explicit Messaging • Troubleshooting • Appendix A - Specifications • Appendix B - DeviceNet Information • Appendix C - PTB Compliance • Appendix D - CD Compliance • Appendix E - Accessories	Hardware Selection Installation and Start-up Maintenance
ControlLogix System User Manual	1756-UM001	ControlLogix	• System Overview • Manage Controller Communication • Place, Configure, and Monitor I/O Modules • Configure Redundancy • SIL2 Certification • Maintain Non-volatile Memory • Maintain the Battery • Status Indicators	Hardware Selection Installation and Start-up Maintenance
ControlLogix Controller and Memory Board Installation Instructions	1756-IN101	ControlLogix	• Replacing a Suspected Failed Controller • Preparing the Chassis • Removing the Controller from the Chassis • Installing a Memory Board • Installing a Compact Flash Card • Connecting a Battery • Installing a Controller into a Chassis • Check the BAT Status Indicator • Check the OK Status Indicator • Updating Controller Firmware • Connecting via a Serial Cable • Interpreting the Status Indicators • Clearing a Major Fault • Clearing a Non-recoverable Fault • Choosing the Operating Mode of the Controller • Specifications	Hardware Selection Installation and Start-up
CompactLogix Selection Guide	1769-SG001	L2x Controller Information	This document contains the necessary information to specify the exact components required to build a CompactLogix based system, including: • CompactLogix Controller Comparison Table • What's new in Version 17 • Example Configurations: – L1X – L2X – L3X – L4X	System Specification Hardware Selection

Documentation Stored On the WWWAT CD

Document Name	Publication Number	WWWAT CD Folder	Document Contents	Reference For
1769 CompactLogix Packaged Controller	IASIMP-QS010	PowerFlex 70 Information	This document contains information on how to deploy a CompactLogix Packaged Controller. This step by step guide includes the following: • How to Assemble the Hardware • Hardware Setups for Communicating between your PC and the Controller • Installing RSLogix 5000 and RSLinx software • Software Configuration for Serial and Ethernet Communications From Your PC to the Controller • Software Setups for Communicating between your PC and the Controller • Loading Controller Firmware • Creating an RSLogix 5000 project. • Downloading to the Controller • Adding Point I/O to the Project • Including a PowerFlex 40 in your application and establishing communications • Creating a simple PanelView Plus Application and Establishing Communications with your CompactLogix packaged controller • Interfacing your CompactLogix packaged controller with a DeviceNet Network • 1769 CompactLogix Packaged Controller User Manual	
Visualization Platforms Selection Guide	VIEW-SG001	PanelView Plus Information	This document contains the necessary information to specify the visualization components required for your application. **Select a Visualization Platform** Determine platform style you want to use: • Dedicated platform (optimized for machine level interface) • Open platform (a device with a preloaded operating system)? **Select a Visualization Product** Choose one of the following visualization products for your application: • PanelView/ PanelView Plus terminals • Industrial Computers • InView Message Displays. Once you have decided on a Visualization product, choose the specific product and software for your application. This section includes the necessary system specification and part number information required to select the correct visualization solution.	System Specification Hardware Selection
E3 and E3 Plus Solid-State Overload Relays Selection Guide	193-SG008	E3 Overload Information	Information required to specify part numbers for E3 and E3 Plus Solid State Overload Relays	System Specification Hardware Selection

Documentation Stored On the WWWAT CD

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Point I/O Selection Guide	1734-SG001	Point I/O	A step by step guide for selecting Point I/O Hardware, including: • Select the Communications Interface • Identify part numbers for specific I/O Modules. You can choose between analog, digital and specialty modules. Module specifications and part numbers are listed. • Select a Terminal Base Assembly. • Select a Power Supply Unit. • Select Point I/O Accessories. • Determine mounting requirements. This section provides information on the spacing requirements for your Point I/O. This information will vary based on the selections you have made in the prior steps.	System Specification Hardware Selection
ControlLogix Selection Guide	1756-SG001	Point I/O	This document contains the necessary information to specify the components required to build a: • ControlLogix- based system. • ControlLogix Controller Comparison Table It also includes detailed step by step procedures to select ControlLogix System components: • Select I/O Devices • Select Motion Control and Drives Requirements • Select Communications Modules • Select Controllers • Select Chassis • Select Power Supplies • Select View Products • Select Software	System Specification Hardware Selection

Notes:

Rockwell Automation Support

Rockwell Automation provides technical information on the Web to assist you in using its products. At http://www.rockwellautomation.com/support/, you can find technical manuals, a knowledge base of FAQs, technical and application notes, sample code and links to software service packs, and a MySupport feature that you can customize to make the best use of these tools.

For an additional level of technical phone support for installation, configuration, and troubleshooting, we offer TechConnect support programs. For more information, contact your local distributor or Rockwell Automation representative, or visit http://www.rockwellautomation.com/support/.

Installation Assistance

If you experience an anomoly within the first 24 hours of installation, review the information that is contained in this manual. You can contact Customer Support for initial help in getting your product up and running.

United States or Canada	1.440.646.3434
Outside United States or Canada	Use the Worldwide Locator at http://www.rockwellautomation.com/support/americas/phone_en.html, or contact your local Rockwell Automation representative.

New Product Satisfaction Return

Rockwell Automation tests all of its products to ensure that they are fully operational when shipped from the manufacturing facility. However, if your product is not functioning and needs to be returned, follow these procedures.

United States	Contact your distributor. You must provide a Customer Support case number (call the phone number above to obtain one) to your distributor to complete the return process.
Outside United States	Please contact your local Rockwell Automation representative for the return procedure.

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Your comments will help us serve your documentation needs better. If you have any suggestions on how to improve this document, complete this form, publication RA-DU002, available at http://www.rockwellautomation.com/literature/.

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